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IMPROVED VARIABLE CUT-OFF.

It is hardly necessary for us to call the attention of engineers to the advantages gained by being able to close sooner or later the steam valve of an engine while the same is in operation. Instead of closing the throttle in order to prevent the machine working off steam faster than it can be generated, in cases where the fullest power is required, and thereby losing much of the elastic force by wire-drawing the steam into the cylinders, that valve can be thrown open. Then, by means of the variable cut-off, the full energy of the steam can be utilized, while the extreme pressure allowed is maintained in the boiler. And, on the contrary, if steam is made faster than the engines can work it off with a fixed cut-off, instead of holding up the levers by hand (as is sometimes the case) the variable cut-off again affords a means of employing the full capacity of the generators.

The cut-off herewith illustrated is especially adapted to poppet valve or side lever engines, such as are in general use on high pressure river steamers.

Fig. 1 is the design used on double engines, such as are in general use on stern wheel boats. Fig. 2 represents an enlarged view of the poppet head, A, Fig. 1, showing more clearly the operation of sliding blocks, C, and roller, D.

The poppet heads, A, Fig. 1, have each a long slot or mortise through which a lever, B, passes. The sliding blocks, C, Fig. 2, are arranged on the top of the lever, B, and under the roller, D, Fig. 2, immediately above the mortise pin, E, Fig. 2. The latter is fastened on the lever, B, works in a slot in the poppet head, and acts as a guide. The blocks, C, are connected by the rods, F, Fig. 1, to the T headed lever, G, which is pivoted to the upper end of the arm, H, that turns on the rock shaft, I. The arm is connected by the rod, J, with an eccentric on the main shaft. This eccentric moves the block, C, in an opposite direction to the piston head. The free end of lever, G, is connected by the rod, K, to the adjusting lever, L, which stands midway between the two engines. The semicircles between which the lever works are notched to correspond with minute divisions of the stroke. By changing the lever in the notches the lever, G, is raised or lowered thereby, and the blocks, C, are drawn nearer together or moved further apart. The steam is thus cut off sooner or later according to the position of the lever, L, which, as represented in our engraving, indicates that the steam is cut off at three tenths of the stroke. It will also be noticed that the inclined end of the block, C, at the right hand, has moved from under the roller, D, allowing the valve to be closed by means of the spring, M, acting on the bar, N.

This cut-off, it is claimed, greatly facilitates the handling of the engine, as, the cutting off being varied at will, the engineer need not leave the throttle when reversing the engines. Fig. 3 shows the device as applied to a side wheel or single engine, as used on side wheel boats, where each engine is handled independently of the other. The eccentric rod is connected to the right and left screw rod, O, at the swivel joint, P. The sliding blocks, C, are connected to the rod, O, by the nuts, Q, so that by means of the crank, R, at the hand of the engineer, the sliding blocks, C, are drawn nearer together or moved further apart by turning the rod, O. Thus the cutting off can be varied at will, when the engine is in motion, to any part of the stroke required, as readily as the throttle can be opened or closed. This variation, it is stated, is made without wire-drawing the steam or pounding the valve seat so as to cause any extra wear or additional expense for repairs. On the contrary the steam valve is guided in its motion. Its velocity, when closing, has been determined by the use of the steam indicator, and hence the angle of the sliding blocks, C. The exhaust valves are not in any way effected by the cutting off.

The invention has been in use for three years on the stern wheel steamer Chin-Du-Wan, in the form shown in Fig. 1, giving, as we understand, entire satisfaction, and this without costing one dollar for repairs. The steam valves, by their positive and accurate motion in closing, have been kept from leaking during the whole three years, while the exhaust valves have been repaired several times. The Chin-Du-Wan is owned by the California Pacific Railroad Company, and has two cylinders 18 inches by 5 feet stroke. The cut-off has also been in use two years on the steamer Petaluma (from the apparatus on which Fig. 3 was drawn), giving the same results as on the Chin-Du-Wan. The Petaluma has two 22 inch cylinders and 6 feet stroke, with single valves, and is owned by the Contra Costa Steamboat Company. The device is also in use on other steamers with like results, and on various land engines.

For further particulars regarding rights to manufacture, etc., address the patentee, Mr. Wm. B. Cross, Sacramento, Cal. Patented January 14 and August 8, 1871, through the Scientific American Patent Agency.

Fig. 1

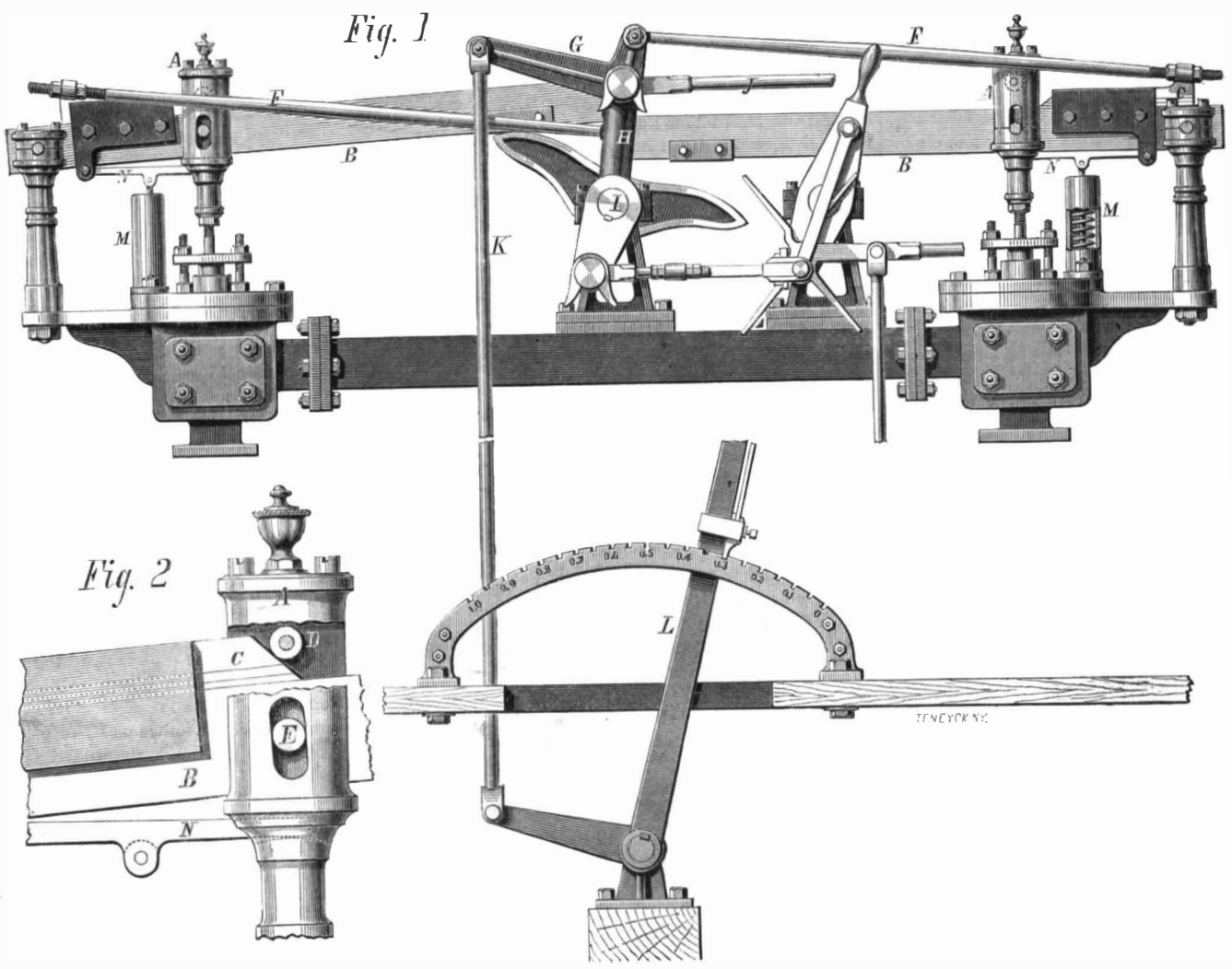
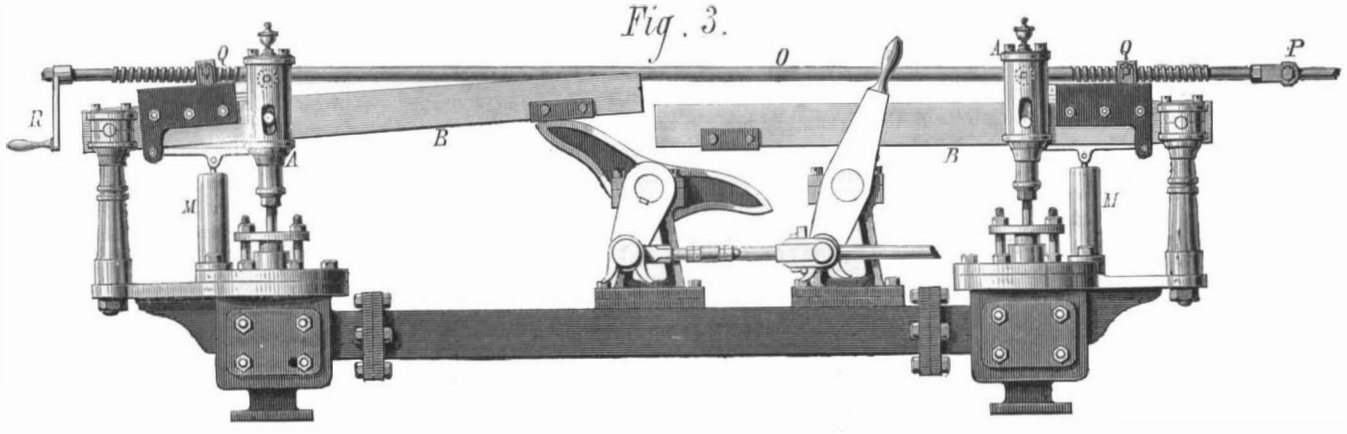


Fig. 2

Fig. 3.



CROSS' VARIABLE CUT-OFF.

A Possible Moses.

The reader of "Put Yourself in His Place" will remember the charming picture which the novelist draws of a child found floating in his cradle the day after the bursting of the Hillsboro' reservoir. Washed from some unknown home among the hundreds destroyed by the pitiless flood, this young navigator had somehow escaped the fate of his kinsfolk; and in happy unconsciousness of danger, was discovered drifting along, kicking up his heels and crowing at the unfamiliar brightness of the sky, and the pretty colors of the birds and butterflies that hovered around.

A sunken Ohio river steamboat afforded, the other day, a still more remarkable and affecting case of infant preservation. The steamer ran on a snag in the night, and sank in deep water, drowning several passengers, among them a number of children.

One of the parents was a Mrs. King, who was, with the rest of the passengers saved, sent on to Shawneetown, Ill., mourning her son as lost. The next morning, the men who went to recover the bodies of the drowned discovered a mattress floating in the cabin, which was filled with water to the ceiling. Peacefully sleeping on this dangerous bed lay a little boy, who had been upborne all night by the water-soaked yet still buoyant mattress. The spasm of hope aroused in the hearts of the bereaved mothers when news came of the miraculous escape of somebody's child, the joy of one and the agony of the rest when the saved was identified, no novelist could conceive or portray. The effect on the mother's future cannot be small. Will it have any influence on the boy's life? Time alone can tell. Certain it is that, if he turns out to be a king indeed, a leader of his fellow men for good, his followers will have a pretty tale to tell of providential interposition to prove the divinity of his calling.

SCORESBY and other arctic voyagers and whale hunters have observed that whales have some means of communicating with one another at great distances. It is probable that the animals bellow in a tone too grave for the human ear, but quite within the range of the cetacean ear.

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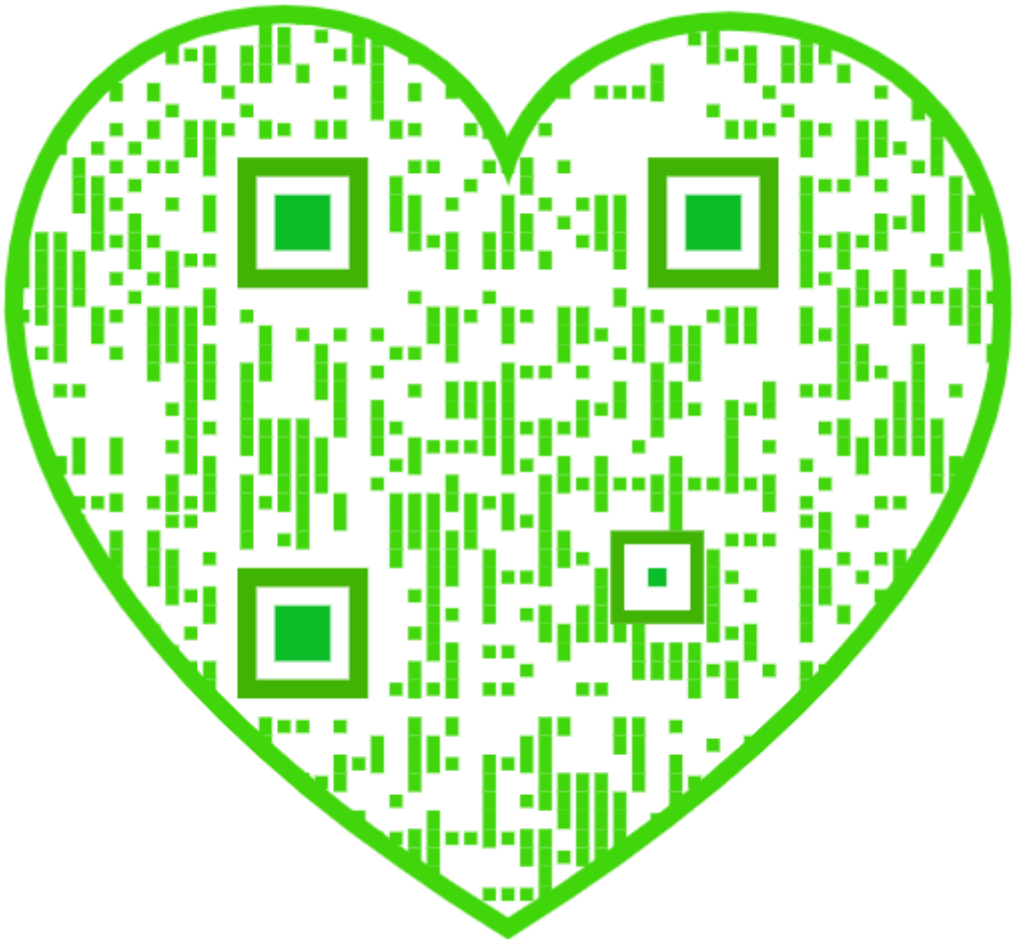

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THE FINANCIAL CRISIS.

One of the incomprehensible financial tempests, which occasionally rage with more or less fierceness in the monetary world, has appeared among the brokers and banking institutions of this city; and although now, it may be hoped, it has nearly passed over, it has left a path marked with victims, in the shape of several of the most prominent houses in a state of either failure or suspension. Why such a violent commotion should have arisen at a period when the business and industries of the country are flourishing, when there is no reason for a dearth of funds in circulation, and to what cause it may be justly ascribed, are questions difficult to answer. It seems as if people suddenly concluded not to lend or expend money or accommodate each other on any terms. Not only on railroad but on every other species of bonds, was it almost impossible to obtain funds; even governments could not be sold until the Sub-Treasury opened its doors for their redemption; and the banking houses not only declined to advance to their customers, even upon the deposit of unusually large collaterals, but in some instances refused to pay out the amounts of open accounts other than by certified checks.

The savings banks, sharing in the general grab, called in all funds due to them, demanding immediate cash payment; while they themselves, taking advantage of the law, refused to meet the drafts of their depositors until the thirty or sixty day notice had expired. This stringency, or rather emptiness, of the money market (for currency was thus completely locked up) created a panic; and, as usual, frantic appeals to the Government for aid, by placing in circulation the reserve fund in the United States Treasury, were made. This, being illegal, was justly refused by the President, so that the financial men of the community, among whom the storm arose and to whom it has been almost entirely confined, are left, with such aid as the redemption of the United States bonds (now ceased) may afford them, to return as best they can to their normal though never quiescent condition.

It has been the general impression that the effects of the panic would be felt by few other than the dealers in money and its equivalent; but it is to be feared that, although mercantile and manufacturing houses have not partaken materially in the disaster thus far, the result of the tightness of the money market will be seriously detrimental to the fall trade and the export of grain and cotton.

DISCOVERY OF AN OLD BOOT AND SHOE SEWING MACHINE PATENT.

The discovery is announced of an old English patent, granted July 17, 1790, to Thomas Saint, for a "Machine for Sewing Boots, Shoes, etc.," which is alleged to contain substantially the same mechanism as that which forms the basis of existing American machines.

We have looked over the drawings and specification of this old patent, and find them rather defective; still it is possible that the machine could be made to work. It makes the loop stitch, contains an awl for punching the hole for the needle, apparently employs the eye-pointed needle, and has a horizontal feed. But if anybody expects by the production of this contrivance in court to invalidate any of our existing patents for shoe machinery, we think they are destined to disappointment. The Saint machine, while it is interesting as an old curiosity, could not possibly be substituted for the effective devices employed in this country. The Saint invention bears about the same relation to modern sewing machines that the ancient revolving pistols do to the existing repeating fire arms. The first, indeed, exhibited the revolving principle, but practically were good for nothing. So of the early attempts at sewing machinery, including that of Saint; they may show the eye-pointed needle, the loop stitch, and a feed, but still are, practically, useless. The ideas of American inventors had to be adopted before sewing machines were made useful to the world.

HOW PIANOS ARE INJURED.

According to a prominent manufacturer, there are more pianos injured by improper tuning than by legitimate use and the consequent natural wear of the instruments. The frame of a good piano, fully strung and tuned, is made to resist a tension equal to about seven tuns. This severe strain relaxes as the strings recede from pitch, but is renewed when the piano is tuned; and it is frequently discovered, as a result of this repeated process, that the frame is bent or bellied; and at the hands of an ignorant tuner or one lacking good judgment, an instrument at this stage is soon injured beyond remedy. With reasonable use, a piano is expected to remain in good condition for seven years, and the best makers will so guarantee their instruments; but the incompetence and malpractice of certain so-called tuners sets the seal of destruction on thousands of instruments in from two to five years.

In tuning a piano, the correct method is to begin in the center of the instrument, on what is called middle C. Yet many tuners, when leaving middle C, instead of going down the scale and tuning the lower notes and heavier and longer strings first—thus immediately bringing the greatest tension to bear upon the frame, and forming, as it were, a solid foundation upon which to operate,—will go up the scale, beginning with the shorter and lighter wires and higher notes, leaving the bass strings until the last, with the invariable result that, when the tuning of the lower portion of the piano is completed, the upper octaves are found to be decidedly away from pitch. Every time a piano is tuned in this manner, it increases the liability of bending the frame and renders the instrument more difficult to tune and keep in tune. The apparent physical effect may be so infinitesimal as to be impossible of measurement, yet a change in the out line of the frame equal to but the thickness of a sheet of tissue paper will produce a difference of nearly a half tone in the sound of any given note. If the lighter strings are tuned first, they relax when the greater strain is brought to bear in keeping the heavier wires up to pitch, with the effect referred to above.

Many tuners do not carefully note the condition of the frame of a piano, and adapt their treatment to the circumstances of the case, with full knowledge that a bent, weakened, or very old frame will not stand the extreme tension or sustain the strings at the high pitch which can be put upon and borne by a frame and wires which have never been injured through ignorance or neglect, and bear no special marks of time or use. There are very few pianos, and those of the best description, that will stand at concert pitch. The piano manufacturers advise purchasers to have their instruments tuned by representatives of the respective factories from which the pianos are sent, as they are aware of the terrible ordeal through which the instruments must pass at the hands of tuners of every degree of intelligence and ability. It is but a fair presumption that the maker of an instrument ought to know how to tune it properly and without injury to its most important parts; yet there are, comparatively, very few persons who profit by the well meant advice, an impression prevailing in some minds that the suggestion is not entirely disinterested, as the makers charge $2 for tuning, while professional tuners and the music stores ask but $1.50, and some of the Bohemians but $1. But were the matter fully and generally understood by the owners of pianos, they would consider it greatly to their interest, even in the light of an investment, to have their instruments tuned by parties in whose hands there is the least possibility of accident or injury.

SAND AND MUD BATHS.

Baths of sand or mud have had a reputation, more or less deserved, for centuries; and at the present day are employed to a considerable extent in different parts of the world. By the former, the inhabitants of the eastern shores of the Mediterranean expect to cure their rheumatic and scrofulous troubles. The process of taking this "cure" is very simple; the patient buries himself almost completely in the hot dry sand, and remains thus, some time after a profuse perspiration has broken out; the perspiration is soon followed by a rash upon the skin, which subsides in a few days.

The little benefit arising from this cure is due in the main to the sweating, which frees the blood from impurities through the pores of the skin, which latter is locally irritated and excited to greater action by direct contact of the sand.

But the latter, the mud baths, so popular on the continent of Europe, among which those of Salzburg, Franzenbad, and Marienbad in Germany have the highest reputation, are really more beneficial. They are prepared in the following manner: Bog mud is thoroughly dried and sifted, then saturated with mineral water, the mixture being made so soft that the body can sink into it; the temperature is raised to about 112° Fahr., and the bath is ready. The baths may be either partial or complete, according to the part of the body to be treated; but in either case, the duration of a single bath is from thirty to fifty minutes; after which the body is cleansed by a warm water *douche*. They are taken daily, early in the morning, until relief is obtained. The diseases to which they are particularly suitable are some kinds of paralysis, muscular rheumatism, and the dull nervous pains which follow severe bruises and which are called weather pains. In former times, their efficacy was thought to depend upon the large amount of iron and salts contained in them, and which were absorbed into the blood through the pores of the skin. It was even supposed that there existed a magnetic current in the mud, which acted as a strong nervous tonic: but at present, the general belief is that the action is simply that of a universal poultice, giving to the entire surface of the body the heat and moisture which we apply to a sore finger in the bread and milk.

Any one who lives near a bog swamp can extemporize a bath, almost as efficient as those of the celebrated watering places, if he have the time and patience to make it; but instead of mineral water, he can use ordinary boiling water or water in which is dissolved a quarter of a pound of green vitriol and half a pound of rock salt. As the heat and moisture are considered the principal parts of this cure, other substances than mud may be used, which, although more expensive, are yet more cleanly; as, for instance, a fine sand or bran, or any material which will mix well with water and retain the heat for some time.

THE MECHANICS OF THE BRAIN.

"There is a just criticism," considers Dr. Edward Fournié, in a paper on the human brain, recently read by him before the French Academy of Sciences, "which may be applied to the efforts of Gall and of those who have followed his teachings in endeavoring to divide, classify, and localize all the manifestations of the human mind. It is that, in place of determining the seat and functional part of the elements which conduce to cerebral activity, a research which constitutes the physiology of the organ, the localizers have attempted to place a mass of manifestations resulting from the working of the brain without pretending to explain the working itself. In other words, they have replaced true cerebral physiology by a synthetic expression of a certain number of phenomena which they have associated with this or that portion of the brain; or, to illustrate, we are told that the faculty of articulate language has its seat in the anterior lobes, while we are left in darkness as to by what mysterious means the idea of speech is formed."

In the living body, three orders of organs may be recognized, the operations of which may be referred either to the laws of physiology or of chemistry. The liver, for example, furnishes a chemical product. A muscle is governed by mechanical laws; it is a motor; while the brain is referred to the laws of molecular dynamics. Like the electric battery, it is the seat of a movement which escapes our observations; but while the pile acts upon apparatus submitted to its influence, the brain manifests itself by its effect upon the muscular system. It is by the movements of the latter that we know that the brain acts, and the full value of this assertion will be better apprehended in considering that the speech (*parole*) with which we think was primitively a muscular movement provoked by cerebral activity, and that we repeat tacitly while we think. Now the essential property of the brain is to feel that which provokes its operation, as well as the act resulting from the latter. The liver does not feel the blood which it modifies, or even that it makes bile; the muscle has no knowledge of the nervous influence which contracts it, or of the displacement which it provokes in the parts, and the electric battery cannot feel that it is in activity and causing motion. Herein the brain stands alone; and in its faculty of sensation, we trace the special properties of the organ.

There are two rival methods of studying the brain—the experimental and the psychological. The latter classifies the manifestations of the mind, but does not explain its functional mechanism. The former, or phrenological system, but demonstrates the material substances through which the efforts of the mind receive a stable, permanent, and sensible form. The one refers to results, the other to physical means. It is only by using both methods, the boundaries between which have been but dimly defined, that our author believes he determines the seat of the anatomic elements which lead to the mechanism of cerebral functions.

The accompanying figure will render clearer the problem which Dr. Fournié sets himself to solve. In the region marked 1 are the nerves of impression, that is to say, the nerves which carry toward the brain the result of an impression received, and which occupy the posterior part of the medulla. These nerves end in region 2, known under the name of optic couches, and are composed largely of nervous cellules. Fibers leading from this center, under form of radii, place it in communication on one side with region 3, composed of cellules, and called the cortical couch of the brain; on the other, with region 4, similarly formed of cellules, and known as striated body. From this last portion lead the nerves which occupy region 5, the anterior part of the medulla. These five regions represent the principal localizations determined by science. It remains to determine their functional *rôles*.

Resembling, in this particular, all living organs, the brain, in order to operate, requires the intervention of an especial excitant. This is an impression received at the peripheric extremity of an impressing nerve. Its effect is to modify the vitality of the nerve, nearer and nearer, until the optic couches are reached, and there the nerve, in its turn, acts upon the cellule in which it ends. The result of this last modification of the cellule is the wonderful phenomenon known as simple perception. This faculty, then, has its seat in the optic couches, a fact capable of experimental demonstration, for if that region be destroyed in a living dog, the animal is insensible to any impression; for example, he cannot smell or see; in a word, he lives but does not feel. In man, when the optic couches are impressed, he simply feels —simple perception and no more. To feel *with knowledge* is, however, a different matter; it is simple perception *plus* something else. What that something else is, is the object of our investigation.

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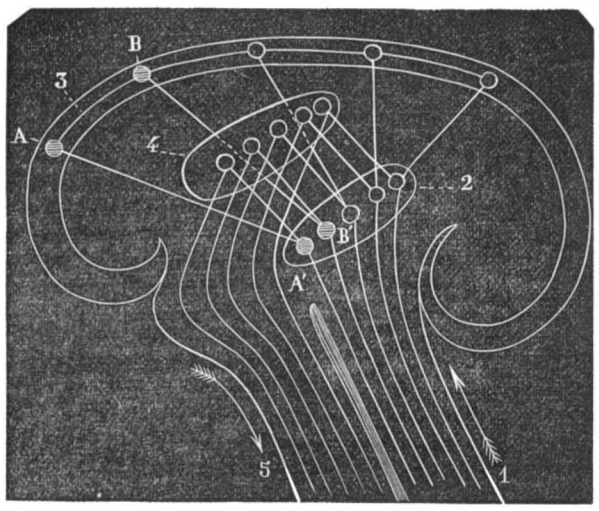
It has been already stated that a motion of the cellules of the optic couches is provoked by the nerves. This movement does not expend itself, however, in that particular region, for the couches are not isolated; hence it continues over the fibers of the white nucleus to end in the cellules which form the peripheric layer of the brain. These cellules are thereby, in turn, modified, and experiments upon living animals and pathologic observations enable the determination of phenomena corresponding to such influence. It has been known for a long time that, in the case of lunatics, the cortical couch of the brain is softened or more or less injured. If that region (3 in the engraving) be destroyed in dogs, a sort of foolishness ensues. The animal has all his sensations, as hvae lunatics, but he is without knowledge or memory.



Hence, while in the optic couches lies simple perception, in the region above alluded to live the reasoning powers just named.

In order to trace the connection which, therefore, must exist between them, let it be supposed that a brain, free from any impression whatever, is submitted to the influence of an odorous body. The movement of the olfactory nerves is transmitted to cellule, A′, of the optic center, and the person recognizes an odor. The vibration continues its course to cellule, A, of the cortical couch, and modifies that region. If, now, the exciting body be removed, the man returns to his former negative condition—perceives nothing. Then, by any means, let the cellule, A, be supposed to be impressed with its proper movement, and thus to be transmitted backward this time to cellule A′, which re-awakens to its special activity. The latter, however, corresponds to a perception of an odor and, consequently, the man will again perceive the same, although the object capable of provoking such a sensation is totally absent. Such is the first condition of memory. But this is merely an elementary fact; in order to remember, a relation must be established between what is and what has been felt—a link formed between past and present. Suppose that the odorous body is an orange, and that the senses of sight and smell are both provoked thereby. The visual impression will awaken the center, B′, at the same time as the odorous impression excites A′; the former will then provoke cellule B, and the latter cellule A, as already shown. The person perceives in two ways, that is all. Now, after withdrawing the orange, suppose it to be submitted to a single sense; let it be held so that the person can see but not smell it. The cellule, B, is excited to activity as before, from the optic couches at B′; and moreover, being united by its prolongation to cellule A, it will determine in the last the special activity pertaining thereto. This, as already described, is reflected back to A′, and the perception of an odor is awakened. Here, then, although the man is too far removed from the orange to smell it, that sense is nevertheless excited, and he will remember that the orange is an odorous body of such a perfume. Not only, therefore, will simple perception be excited, but perception with knowledge.

The cellules of the cortical couch of the brain represent, under form of dynamic modality *in posse*, all acquired ideas, and it is to the anatomic connections which unite these cellules to the optic couches that they borrow the possibility of awakening successively the center of perception to give birth to the phenomena of memory. A dream is nothing but the awakening of this center of perception, by the activity of the cellules of the cortical couch, while this same center is shut off from exterior influence. All the cellules of that couch are united among themselves, and they can mutually awaken their respective activities. It is enough if one operates to cause the rest to follow. The classification and admirable ordering of our knowledge is the work of the Creator; the brain is like tapestry, of which God gives us the canvas and we fill in the stitches in designs more or less grand.

Thus far we have referred to but a portion of the cerebral functions, the functional excitant and the functional matter. The duty of the organ does not consist merely in collecting determined elements; it is supposed to work with some object, to attain an end which is not within the brain itself but outside. There must then be particular motions which the organ projects without itself, and these are termed functional movements.

The path we have just assigned to the impressing movement or vibration of the sensitive nerves to the optic couches and thence to the cortical cellules is now the only route followed by such motion. The optic couches are united by special filaments to another nucleus of cellules called the striated body. Here end all the fibers of the motive nerves placed in the antero-lateral part of the medulla. There is a presumption already indicating the function of the striated body, which however is transformed into a certainty when, on destroying such portion of the organ in living dogs, the total cessation of physical movement succeeds. Reasoning from this we can explain the functional mechanism of voluntary and involuntary motion.

Involuntary movements take place when the impressing cause, a danger for example, is sufficiently sudden to awaken instantly the activity of the striated body and as quickly provoke, through the intermediation of the motor nerves, a determined motion of the muscles. The movements of the body are voluntary when the impressing cause acts slowly enough for the perception to travel to the cortical couches and arouse the activity of the cellules. It is not until after the examination of the impression, in connection with acquired knowledge, that the movement takes place. In involuntary motion, the effect is a start, a sudden withdrawal of a member, an inarticulate exclamation, etc. In voluntary movement, the previous examination causes a dominant impression to prevail in the optic couches which gives to the effort a motion as if it had been considered and reasoned upon. To the last belong the movements incidental to speech.

SCIENTIFIC AND PRACTICAL INFORMATION.

RELIGIOUS ELECTRICITY.

Recently in New York city, at the dedication of the new and splendid Jewish synagogue, corner of Lexington avenue and 53d street, a portion of the first chapter of Genesis was sung by the choir; and as the words "Let there be light and there was light" were uttered with a grand burst of melody, the whole church was instantaneously lighted up by electricity. Thus it is that modern science lends her aid to give effect to the solemnities of her servants.

RESTORATION OF OIL PAINTINGS.

It appears that the brilliancy of the colors in oil paintings is due to the optical properties of the substance, contained in the oil, known as linoline. By exposure to the air this substance, at first liquid, absorbs oxygen, becomes solid and transparent, firmly enclosing the particles of color. Linseed oil contains 80 per cent of this linoline. By lapse of time and physical and chemical changes, the linoline loses in some degree its transparency and the picture fades, those colors containing the least oil changing most.

Pettenkofer has discovered that the vapor of alcohol will renew the qualities of the linoline, and he restores old oil paintings by placing them over a tight box, in the bottom of which is a flannel cloth, which has been dampened with alcohol of 80 per cent strength. The arrangement should be such that every part of the picture will be exposed to the alcoholic vapor.

THE FAIR OF THE AMERICAN INSTITUTE.

The exhibition building is now filling up quite rapidly, and nearly double the number of articles are in place that was the case at the time of our last visit. There seems to be an improvement in the arrangement of tables and space which admits of a much better display and at the same time economizes much room heretofore wasted in needless passages. Two wooden extensions are in process of construction beside the main building, in one of which will be a Campbell printing press, and in the other a huge saw mill. The excellent and instructive plan of exhibiting an industry by its processes in actual operation, we are pleased to note, is in some cases being carried out. A shoemaking firm enable the visitor to trace the entire manufacture of the shoe from its first cutting from the hides down to the finishing polish. The workmen are seated around the enclosed space, and the shoe passes from hand to hand, each man adding to or perfecting some portion. The extent of the crowd that constantly presses against the railing, eagerly watching the various manipulations, is a convincing proof of the interest taken by the public in such displays. In the same portion of the hall, a number of tailors are at work, cutting out, basting, sewing and pressing men's clothes; and about midway along one of the side aisles, an ivory turner makes billiard balls, chessmen, handles, etc., from the crude material, while another workman engraves monograms and designs on the finished articles. The display of fruit this year is exceptionally large and fine. There are some gigantic grapes and pears from Nebraska, and innumerable plates of apples, of excellent appearance, from various points of the West. The floral exhibit is as yet rather slim, but probably will be augmented when the Fair becomes completely organized. Evidences of improved management are plain; especially in the absence of the vendors of grease compounds and similar nostrums, who made their surroundings hideous with their yells, and provoked the ire, of every exhibitor in their vicinity, during the exhibition of last year.

We resume our brief notices of such inventions as have attracted our attention, from their novelty or especial utility during recent visits. M. T. Boult's

MACHINE FOR CARVING,

paneling, molding and dovetailing in wood, is an excellently constructed and apparently very efficient device. It is four machines combined in one. The dovetail arrangement is a separate attachment connected with the table, which makes both tenons and mortises at once, so that it only remains to fit the portions together. The paneler is a revolving cutter, working upwards on a vertical shaft under the table. The pattern is fastened on the opposite or upper face of the plank while the lower side of the latter is pressed against the cutter. We examined the operation of the machine quite at length, and found much to admire both in the simplicity of its mechanism and the beauty of the work turned out. Young's

DIAMOND SAW

is at work in the machinery department, in the form of a neatly built iron model, one fifth the size of the more cumbrous wooden apparatus. The blade, it will be remembered, cuts through the stone by means of carbons or black diamonds which are securely set along its edge. There is an ingenious feed motion for moving the saw, and another device to lift the latter, consisting of an eccentric on the crank pin communicating with a knuckle joint and levers, so that it is allowed to cut only in drawing. The small machine exhibited, we were told, penetrated brown stone at the rate of 14 inches and marble at 7 inches per hour. A novelty about this invention is its application to the cutting of window moldings. Bevels are made by suitably turning the stone, and rounded edges by gradually moving the latter under the saw. The work exhibited to us was very smoothly cut, and especially noticeable for its clean and sharp angles. The apparatus, the inventor thinks, does the labor, in molding, of from 12 to 14 stonecutters. Lyall's

CORSET LOOM

is a most remarkable combination of the Jacquard card with the well known positive motion loom. The cards are hung in an endless chain in a frame work in the upper part of the machine, above the two rows of beams. These communicate with the harness, by the usual mechanism, so as to lift certain portions of the warp at certain times. Four strips or webs of corset are woven at once. To give a clear idea of the operation of the machine is hardly possible in mere words. If the reader, however, will imagine that half the warp in an ordinary loom, for instance, be pushed out of the way, and that the shuttle travels a dozen or so times through the portion left, then that the whole warp be allowed to come into action and the weaving go on as usual, it will perhaps be understood that there will be a gusset in the cloth formed by the half action, so to speak, of the filling. This, though crudely expressed, is about the operation of the Lyall loom. The Jacquard cards govern the quantity of warp to be kept in action, and this quantity is so graduated as to form the requisite gussets, welts, and gores. The shuttle consists of a box enclosing the bobbin, the thread from which passes around and through extended springs. By this ingenious arrangement the slack loop, which would result from the shuttle not passing through all the warp, in forming gussets as above described, is taken up and the thread kept taut. The winding of the finished web brings in another very ingenious though simple arrangement for taking up the irregular portions. There is an endless rubber belt pressing against the cloth from above. Below the latter is a strip of wood filled with needle point projections. The needles, while the whole warp is being filled, catch the entire web and, by the action of the rubber belt, pass it along. But when, however, only a portion of the width is being woven, the needles hook the inoperative part and hold it while they allow the part which is being increased to pass on.

The entire invention, which we have thus necessarily only faintly outlined, is of great ingenuity and may justly rank as one of the most important of modern improvements in the trade to which it relates.

A WIRE BRUSH MACHINE,

which puts us very much in mind of a pin-making apparatus, is at work in the main hall. It makes hair brushes, or in fact brushes for any purpose, out of fine tinned wire instead of bristles. The wire is led from the coil up to the back of a long strip of india rubber, and is moistened with camphene so as to penetrate the same with readiness. On setting the machine in motion, an awl first makes a hole in the band then the wire is brought up, cut by a blade, and dies hold it while a little swedge forms a head upon its end. Then a pusher drives it into the awl hole and through the band, where it remains. The number of pieces in each row is regulated by an ingenious cam device, which causes them to take the elliptical figure peculiar to hair brushes. It only remains to cut the band into suitable lengths and attach it to back and handle to complete the brush.

Near the apparatus just described is an

ENVELOPE MAKING MACHINE.

The paper, previously cut into proper shape, is placed under an angularly shaped plunger, kept covered with gum. This pushes the piece down through a correspondingly shaped slot and at the same time pastes the lower edges. Two arms then swing around and push the paper under another plunger, of different shape, which carries the piece through a square hole of the size the envelope is to be. The edges are next doubled over by swinging metal plates, arranged on the sides of the slot, and the envelope remains in its place until another arrives, when it falls into a suitable receptacle.

There is a peculiar horizontal steam pump, Eickemeyer's, in a corner of the machinery department. At the middle of the piston is a short arm which, by a ball and socket joint, connects with a yoke on the fly wheel shaft. The piston has thus a partial rotation on its axis, and so forms a self-operating valve for both pump and steam cylinder.

A rather queer invention is the

STEAM BOOT BLACKER,

which consists of brushes which rub the sides and top of the boot and another made in shape to conform to the heel. There are attachments for a supply of water, and other brushes for removing mud, etc. The mechanism is quite simple, and agitates the brushes at a rate which might carry dismay to any one who is afflicted with corns, bunions, or tender feet.

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IMPROVED BORING MACHINE.

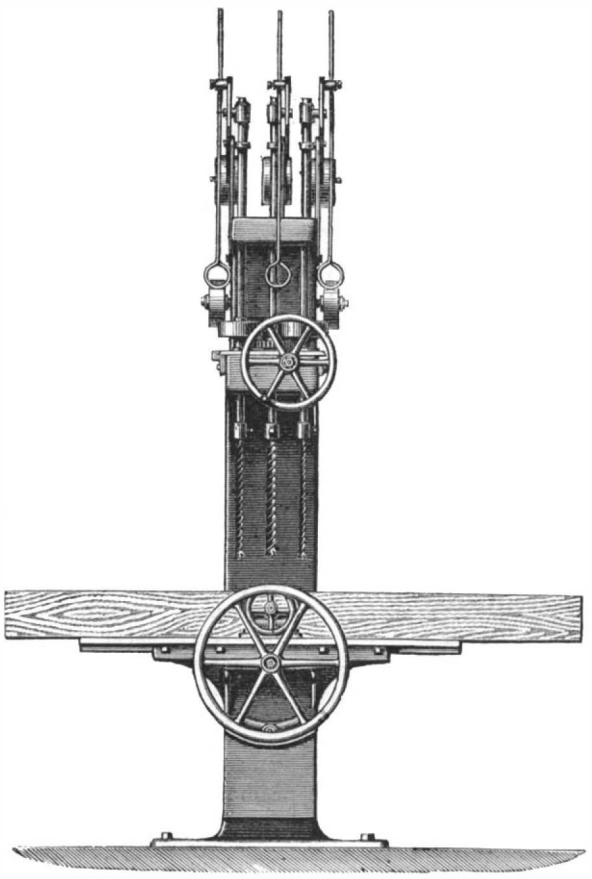
One mechanical difficulty that has presented itself in the construction of boring machines with vertical spindles has been to change the driving motion from the horizontal shafts to the spindles. To this end rough wheels have been used, but these, in addition to that of the limited speed at which they can be driven, are open to the objections of wearing out the bearings and creating noise. The lateral strain upon shafts being as their distances from the center at which the power is applied, it is evident that the strain upon the bearings of boring or drilling spindles, when small wheels are employed, is almost as great as it is upon the teeth of gearing.

Although the operation of wood boring is a light one, so far as the mere cutting is concerned, yet the supporting and adjustment of the timber requires a strong machine. Boring, as a rule, is performed on the heavier class of lumber, such as is joined or framed by means of bolts, instead of tenon and mortices alone, and the appliances for handling the same are therefore necessarily of substantial construction.

We publish herewith engravings of a new machine by Richards, London, and Kelley, of Philadelphia, that combines several improvements, and is claimed to meet most of the objections that we have pointed out.

The spindles, three in number, are driven by one belt that is carried around the pulleys so as to give the greatest tractive power; and no gearing, except a single pair of spur wheels, is used. These wheels are engine cut, and may run at any speed required. The spindles are moved across the lumber by means of the hand wheel seen in front, and have a boring range of 18 inches. The several spindles can be fitted with augers of various sizes, so that all the boring may be performed at one operation when there are not more than three sizes of holes to make in each piece. The table, or carriage, is very strong, arranged with a diagonal clamp and pivoted so that angular holes can be bored. All the movable joints are fitted by scraping, and the whole seems well adapted to the severe use that boring machines receive in our large railway carriage and other woodworking establishments.

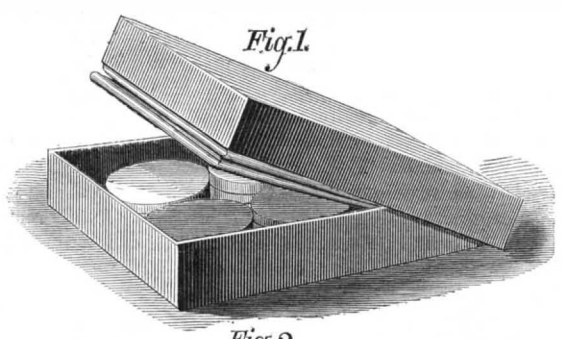
We are informed that patents on these improvements will soon be applied for.

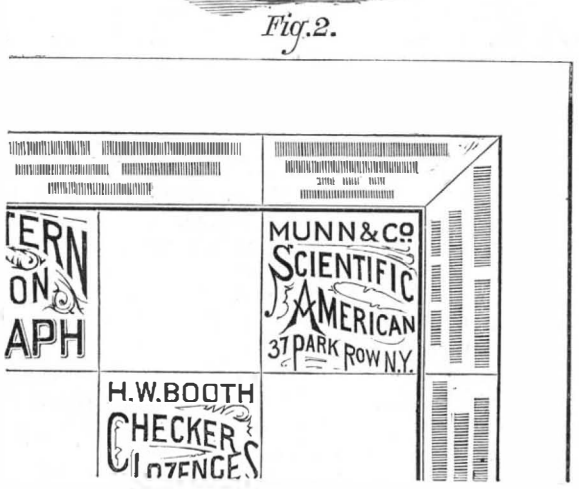


WOOD BORING MACHINE.

CHECKER LOZENGE PACKAGE.

There is probably no one of our readers who, while traveling in a railroad car, has not had packages of gum drops or prize candy unceremoniously tossed into his lap and left in his charge during the peregrinations of their somewhat grimy vendor through the train. The advantages of this plan of selling sweetmeats need not here be pointed out; the disadvantages consist in that the purchaser, after he has absorbed the candy, is without further employment than that to be obtained from the perusal of the wrapper or from dismal forebodings of the probable effect of his repast on his teeth and digestive organs.





The merit of the novel idea which is represented in our engravings will therefore be fully appreciated, particularly as it combines in a single package not only a quantity of candy, but the necessary articles for playing a game of drafts or checkers, thus affording an agreeable means of whiling away the hours of a tedious journey. The box is about the size of the ordinary twenty-five cent packages. Its contents consist of twenty-four lozenges—twelve white and twelve red, of two different flavors—and also of a sheet of paper printed in squares. The divisions of the board, instead of being dead black and white, are formed by printing advertisements in alternate squares, so that the player, while meditating over his moves, has directly under his eyes the announcements of various business houses. The advertisements are either "set up solid" or "displayed," as shown in Fig. 2, and, besides occupying the squares, extend around the edges of the sheet.

The device seems quite novel and should prove a saleable article in confectionery stores as well as to travelers. The candy is, we are assured, pure and free from all deleterious ingredients, and is made by machinery at the rate of two tuns weight per day. The advertising sheet will doubtless commend itself to enterprizing firms as an ingenious mode of bringing their business to public attention.

Patented through the Scientific American Patent Agency, June 18, 1872, by Mr. H. W. Booth, corner of Don and River streets, Toronto, Ontario, Canada, by addressing whom further particulars regarding sale of patent may be obtained.

American Scientific Schools.

We of Young America, like other good children, feel a natural exultation in commendation which comes from father-land or mother-country; and thus we Scientific Americans may take pardonable pride in such praise of one of our American schools of science as is contained in the following extract, from the *Chemical News* of August 29, just received:

Programm der Königlichen Rheinisch-Westphälischen Polytechnischen Schule zu Aachen fur den Cursus 1873-74.

Announcement of the Stevens Institute of Technology, a School of Mechanical Engineering founded by Edward A. Stevens. Hoboken, N. J., U. S. A. 1873.

We owe, to the courtesy of the directors of the establishments just alluded, to the opportunity of calling attention to two excellent schools established, the one by the care of the Prussian Government, the other by the munificence of a late eminent citizen of the great Transatlantic Republic.

In the programme of the Polytechnic school at Aachen (Aix-la-Chapelle) we meet with a very clear and succinct review of polytechnic science in all its bearings and its applications, as taught by a staff of some forty teachers, while the headings of the various subjects in which instruction is given amount to about one hundred. The school is now attended by about four hundred pupils, many of whom are natives of non-German countries.

Although an institution due to private munificence, the Stevens Institute of Technology can worthily vie with the now already celebrated School at Aachen. The Stevens Institute is just as much a high polytechnic school as the German one, and to the eminent President of the American school, Dr. H. Morton, high credit is due for the manner in which he has assisted the trustees of this foundation to carry out the will of the late Mr. E. A. Stevens.

Our space does not permit us to enter into a detailed review of the two volumes, the titles of which are recorded above. Both books have a permanent value, and the American contains, aided by woodcuts, a description of some of the most prominent portions of the contents of the museums and collections of apparatus for illustrating lectures on physical, chemical, and engineering sciences. While calling attention to these institutions, we cannot but express our great regret that in this country nothing exists which even approaches either of the two establishments of which the programmes have been courteously sent to us.

SPRAGUE'S COMBINED SASH LOCK, SASH HOLDER, AND WEATHER STRIP.

The chilly evenings and mornings of the present month will be a reminder that cold weather is not far distant, and consequently that it is time to take the necessary precautions for keeping the warm air in as well as the chilly blasts out of our dwellings. With chinks open around the windows, a comfortable house is hardly a possibility, so that we presume there are few who will not avail themselves of some form of the well known "weather strip." The invention which we illustrate in our engraving may, therefore, perhaps prove a welcome device to many, particularly as it is especially adapted to windows which are minus cords, pulleys, or proper locks, a state of affairs frequently the case in country houses.

The arrangement consists of a strip, A, resting alongside the sash, B, Fig. 2, on springs, C, placed to receive it, and secured by screws, D, with their heads against shouldered sockets, so that the movement of the piece, as regards sash and frame, may be regulated. The strip, A, is covered on its face with leather, so that it forms a tight weather strip, and by its elastic movement permits the sash to be held up at any desired point.

A section of this batten, E, forms the locking bolt, and is constantly pushed outward by a spiral spring, F. When opposite the recess in the window frame, as shown in Fig. 1, the action of the spring forces the pivoted section therein, thus firmly locking down the sash. When it is desired to raise the latter, it is only necessary to pull down the hook lever, G, which contracts the spring and withdraws the locking piece. The section, E, is faced and forms a continuation of the weather strip; and by jointing it to the lower end of the piece, A, the device is rendered suitable for the upper sash.

Patented by Mr. E. J. Sprague, July 22, 1873. For further particulars concerning the sale of rights, etc., address the proprietors, Sprague & Miller, P. O. Box No. 17, Youngstown, Mahoning county, Ohio.

THE Brazilian cable expedition is at Madeira, and the line connecting that island with Portugal has been successfully laid.

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THE EVAPORATION OF WATER BY PLANTS.

In order to measure with precision the quantity of water necessary to maintain a plant constantly in a proper condition of moisture, it is necessary to determine the enormous amounts of liquid which the vegetable evaporates. The method of obtaining such result is quite imperfect, for since metallic plates are arranged over the plant and pot so as to cover completely the earth, and it is impossible to hinder an evaporation from the surface of the soil, it is manifestly difficult to affirm that all the fluid employed in the watering has traversed the plant.

M. Deherain communicates to *La Nature*, to which journal we are indebted for our illustrations, records of his investigations in the subject, which have extended over several years. In order to collect the water evaporated, he fixes a leaf of the plant in an ordinary test tube by means of a split cork. The tube is held by a support so as to retain the leaf in its normal position (Fig. 1). When the apparatus thus arranged is placed in the sun, dew quickly appears on the interior of the cylinder, and augments rapidly until, at the end of an hour, a quantity of water may be collected, often equal to, and sometimes of twice the weight of, the leaf. In several examples given by the author, we note that of a leaf of wheat, weighing 36·1 grains, yielding, in the above period, 30·1 grains of water, equal to 88·2 per cent of the weight of the leaf. A more striking instance is that of corn leaves gathered after a prolonged drought, giving 229, 187, 179, and 178 per cent of their weight in water, the largest proportions yet determined.

In order to obtain from the leaves such excessive quantities of fluid, it is necessary to expose them to the sun for a time: for if they be submitted merely to diffuse light, evaporation diminishes perceptibly, while it ceases almost entirely in darkness. A wheat leaf exposed to the sun gave, as above noted, 88·2 per cent of its weight of water; in diffuse light this proportion was reduced to 17·7 per cent, and in darkness to 1·1 per cent. These experiments are very simple and easy, and any one interested in the subject can repeat them for himself with little trouble.

It appears difficult, from the above results, to avoid the admission that light has a decisive influence on the phenomenon. In order, however, to render certain the fact that the abundant transpiration in the tube was not due to a warming of the confined air by the sun's rays, during the entire experiment the leaves were kept at a low temperature, either

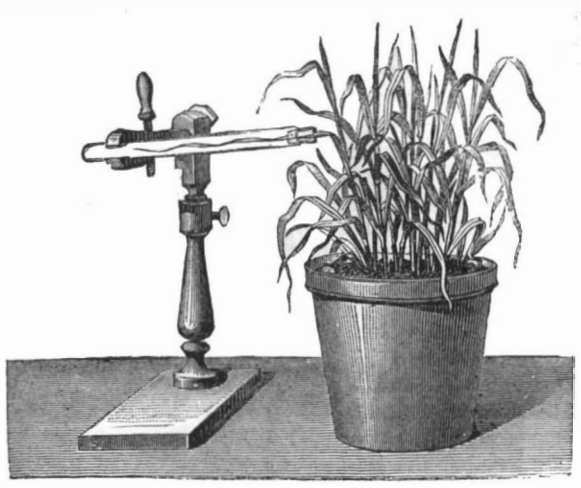

FIG. 1.—Apparatus showing the quantity of water evaporated by leaves.

by placing the tube within another, through which passed a current of water (Fig. 2), or surrounding the inner cylinder with crushed ice, which was constantly renewed. Thus arranged, a wheat leaf, weighing 2·7 grains, gave 2·5 grains of water in the sun and only ·045 grain in darkness. The liquid between the tubes was kept at 59° Fah. At a temperature of 39·2°, gained by the aid of ice, in an hour in the sun, the leaves gave off 108 per cent of water.

It is, then, the luminous heat which determines the evaporation as well as the decomposition of carbonic acid by the leaves; and it is curious to note whether, in pursuing the comparison, we should eventually recognize that the luminous rays, potent in determining the decomposition of the carbonic acid, are equally efficacious in favoring evaporation. In causing the first mentioned effect, the brightest rays, red and yellow, are known to be the most active. This fact may be determined by placing a marsh plant in a weak solution of carbonic acid and then surrounding the vessel with a cylinder containing various colored liquids. It will be found that the green and blue rays, which blacken photographic paper so rapidly, act but feebly, and cause but a very light disengagement of oxygen, while, on the other hand, the red and yellow rays, inoperative on sensitized paper, are singularly energetic in causing the decomposition of carbonic acid. Now, precisely these same rays favor the evaporation of water by leaves, and this is experimentally demonstrated in the apparatus represented in Fig. 3. The tube holding the leaf is placed in a glass, which is filled with a colored solution arranged so as to be easily drawn off and replaced, when necessary, by other liquids. The leaf is then caused to be illuminated by variously tinted lights, and it is found that the efficacy of the rays in determining evaporation ranges in the following order: yellows, reds, blues, and greens. When the outside vessel contains a yellow solution, a quantity of water double that given off by the leaf when submitted to a green light is collected.

Analogous results are obtained by using the solar spectrum obtained through a glass prism. The light (Fig. 4) is reflected by a heliostat to the prism, undergoing separation, and the tubes are arranged in various parts of the refracted

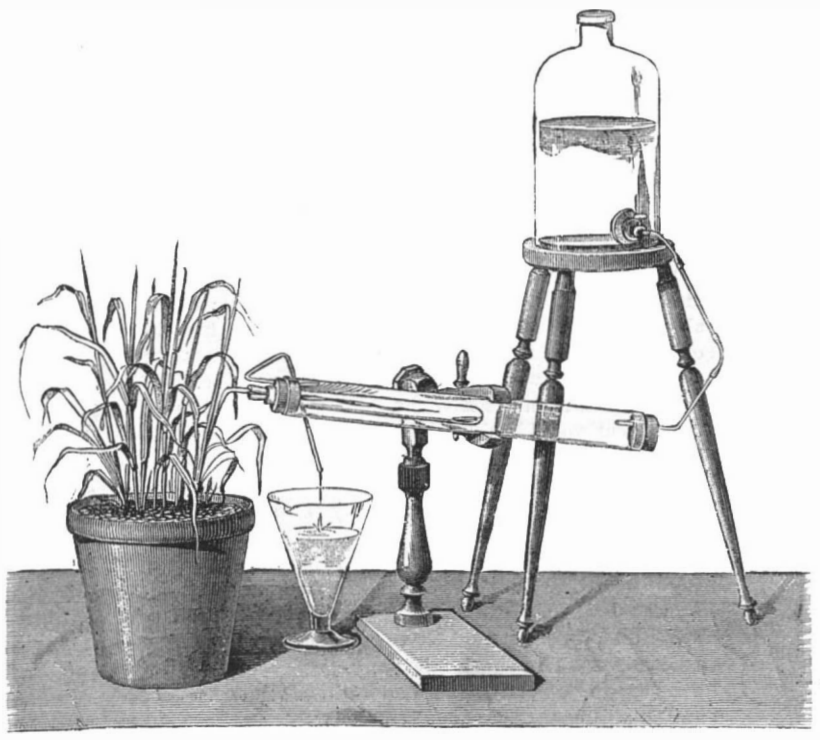

FIG. 2.—APPARATUS SHOWING THAT THE EVAPORATION IS DUE TO LIGHT.

rays. The facts already recorded are plainly discernible.

It may be considered, as determined from the preceding, that the rays efficacious in causing the decomposition of carbonic acid are also those which favor the evaporation of water by leaves, and thus two very important phenomena of vegetable life appear to be connected by a bond, the nature of which is still unknown.

By determining the evaporation of a cultivated surface, we may be able to draw important conclusions on the quantity of water which it should receive in order that the growing plants thereon may prosper. It has been found that in a thinly planted field of corn, where thirty stalks were counted per 10·7 square feet, the weight of the leaves was about 3,732·6 grains. These leaves on a clear day gave off at least 150 per cent of water per hour, or in ten hours 1,500 per cent. The 3,732·6 grains of weight of the latter should therefore give off 55,902 grains of water, or something over one gallon. If, therefore, 10·7 square feet (square meter) yield a quantity equal to some 6·6 pounds, 2·4 acres (hectare) will give about 33 tuns. This is not far from the conclusion reached by Hales, a celebrated English naturalist, nearly a century ago, as he estimated that 20 acres planted with cabbages evaporated 706 cubic feet of water per day, while more extended investigations by Schleiden, the botanist, on fields of grass and clover, gave 21 tuns per similar area.

These figures, however, relate to ordinary and general agriculture, fields, etc.; but if we consider the cultivation of vegetables for the market—kitchen garden culture—we should find, corresponding to the quantities of irrigating water, results infinitely more elevated. It is estimated that the kitchen gardeners of Paris throw, per year, upon the rich soil, water equal to a depth of 12·8 feet. Considering that cultivation continues for 250 days per year, for in winter it almost entirely ceases, it is found that every 2·4 acres receives daily 5,648 cubic feet of water. The result is that, thus treated, the earth yields crude products to the value of from four to six hundred dollars per 2·4 acres instead of from one to one hundred and fifty dollars, as would be the case in extended agriculture.

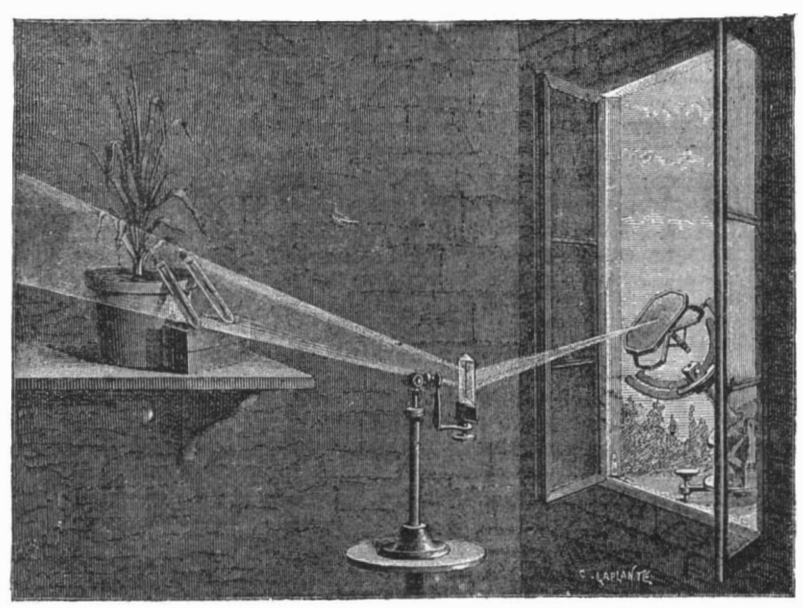

FIG. 4.—APPARATUS FOR DISTINGUISHING THE EFFECTS OF THE RAYS OF THE SOLAR SPECTRUM.

Floors of Mortar in Mexico.

General T. G. Ellis describes, from personal observation, the following method used in Mexico:

"The limestone used was a hard, compact, blue material, in some places sufficiently hard to strike fire on the drills used in running a drift through it for mining purposes. It often contains iron pyrites in small proportion. This was calcined in kilns cut out of a very soft limestone, that likewise is found in that section of country, and which, on account of its whiteness and softness, is called *cal lèche*.

After calcination the lime was removed from the kilns, and slaked as soon as cool. Some of it was used within a day or two, and some remained a month or more in barrels. All the work made with it seemed to be equally good.

In making the floors, a layer of broken limestone, three or four inches thick, was first laid evenly over the surface of the ground, the stone being about the usual size for macadamizing roads. Over this a mortar of about two parts of sand to one of lime was carefully and evenly spread to the thickness of 1½ or 2 inches; this was allowed to remain for about twenty-four hours, or until the surface had become quite dry. It would probably take longer in this climate, where the air possesses a greater amount of moisture than in Mexico.

The floor was then thoroughly pounded all over with a tool composed of a block of wood about 1 foot square and 3 inches thick, having a handle rising from the middle, so that a man could stand while using it. The whole surface was beaten down with this ram until it was again as soft and moist as when first laid. This operation of ramming brought the water in the mortar to the surface so as to form a layer of semi-fluid substance on top.

The floor was again allowed to dry, and again beaten over each day for about a week, when the operation brought only a slight amount of moisture to the surface.

Immediately after the last pounding the whole surface was powdered with a thin layer of red ocher, evenly sifted on, and then polished as follows:

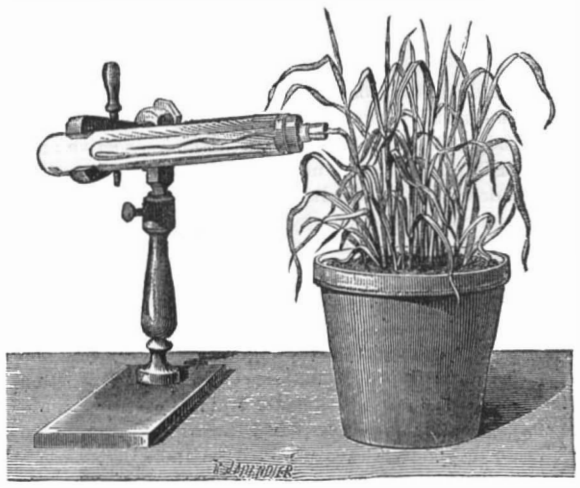

FIG. 3.—Apparatus for distinguishing the effects of variously colored rays.

A smooth, nearly flat, water-worn stone, a little larger than the fist, was selected from the bed of the stream which ran through the place, and with this the whole floor was laboriously gone over, rubbing down, and leaving the surface of the lime as smooth as a piece of polished stone, the red of the ocher rendering it of a rich brown color.

In less than a week the floors made in this way were sufficiently hard to bear the weight of a horse without indentation. Roofs were made in the same manner, without the coloring matter, which was added only to give the floors a better tint than the gray of the mortar. These roofs were perfectly waterproof, and were unaffected by sun or rain.

In the city of Monterey, sidewalks in the principal streets are made in the same manner, and some of them have lasted for years, wearing through like a block of stone.

The great durability and strength of these floors and roofs are entirely owing to the pounding operation above described, as the same materials were tried in the ordinary way without success.

The writer has not had occasion to make use of this process in this climate, but gives a description, hoping that it may be of value to others who may have occasion to lay floors of lime in architectural or engineering works. He has never heard of this method being employed in this country; although it seems singular that it should be used so generally by a neighboring nation, and be wholly unknown to our builders."

Our readers will perceive that this method of

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using mortar is analagous to the French mixture known as Coignet's *béton*, which, when thoroughly rammed as above described, forms artificial stone of great strength impervious to water. M. Coignet appears to have been long anticipated by the Mexican builders.

Correspondence.

The Manifestation of Energy in Nature.

To the Editor of the Scientific American:

If we would ignore the assumed existence of the hypothetic ether, and look upon every particle of matter as being the center of a ubiquitous sphere of static energy or influence, natural phenomena could receive a better explanation. From our knowledge of matter we say that it is indestructible; and as every portion manifestly influences in its motion every other, we may say that its energy is practically ubiquitous, and continually exercised for the attainment and maintenance of equilibrium. Faraday supposed the existence of "physical lines of force;" and both Thomson and Maxwell show that this hypothesis gives a more correct view of electro-magnetic action than the usual mathematical expression. As then all that we know of Nature is summed up in matter and energy, we may fairly assume the physical existence of both, while looking upon the essential nature of either as beyond the reach of speculation. By this means we rid ourselves of unwarrantable hypotheses. Space becomes neither a vacuum nor filled with one or more impossible ethers. Electric or magnetic phenomena are not action at a distance, but action along unbroken lines of induced force within a body's sphere of energy, the transversal vibrations of such lines when broken into an advancing wave constituting heat and light.

The constitution of every cosmic system proves the physical existence of energy. Static potency is inversely as the distance from the center of exerted power, as shown by the lever or balance. The centripetal force varies inversely as the square of the distance, the centrifugal as the cube. This makes the revolving force to vary inversely as the distance, when both tendencies are produced from the same center, as in the common illustration of a sling—constraint and outward motion acting along the same connecting line. But the physical connecting line is necessary. Now we find, in every cosmic system, the energy of motion (velocity squared) of every revolving body to be inversely as its distance from the united balancing center.

The solar system, say, represents a certain amount of energy—that of the matter composing it—and is formed in the universal tendency to equilibration, by the matter blending its energies into one common concentric sphere for the mutual balance of the various bodies. The laws of Kepler, in regard to which there has been so much speculation, become inevitable. Equal areas are moved over by each body in equal times. As the force of motion is inversely as the length of radii in the concentric spheres encircled in revolution, the linear length defines the time occupied in motion by each body. The radii squared give the respective areas swept over in revolution. The areas (radii, or times squared) therefore, described by the different bodies, must be to each other as the volumes of energy in the concentric spheres of which they are great circles. The squares of the radii for areas are to each other as the cubes of the same for the volume of energy, which gives the areas to be moved over.

The blending of energies into one common center of balance explains the law of gravitation. For matter must approach until stable equilibrium is attained by the proportional masses, at the necessary distance from the united center of gravity. But by the principle of the conservation of energy, when the bodies have attained balancing distance in free space, the force of approach necessarily becomes transformed into revolutionary motion. Of this deviating force, the Newtonian law renders no account. But the ascription of physical energy to matter, with its universal tendency to equilibrium, not only explains but shows the necessity of the conservation of both centripetal and tangential tendencies.

The theorems of La Grange and La Place are necessitated also by the physical reality. For that definite amount of energy which centered itself for the equilibrated motion of bodies cannot otherwise than conserve what it formed, local action being continuously neutralized by counter strain.

My conclusion, then, is, that matter and energy are physical realities, because they constitute all that we know of Nature. The energy of every particle of matter we look upon as universal because it acts upon all others. The energy of every body is exercised in maintaining or in striving to attain equilibrium with all others, and may act either attractively or repulsively, according to the most powerful enforcement or solicitation; we find that Nature teaches this also. To this variation of action, according to molecular constitution, must be ascribed cometary eccentricities. In apparent defiance to the gravitating law, cases of division and permanent separation of parts have been witnessed. Static potency is inversely as the distance from the center of balance; as we see that a small body will, by a nearer approach to the center of the earth, raise a much larger, if only at a greater distance from the balancing center, although both originally were at the same distance from the earth's center, and the larger body attracting according to its mass. Radiant action, or vibration from the center of a body's sphere of energy, outwards, must vary with the square of the distance, and also tractive potency if acting in all directions. Such variations of potentiality bring about all natural charges amidst all tendencies to equilibrium; and the amount of energy in the universe is measured by its matter. The energy of the atom is no less universal than indestructible.

Philadelphia, Pa. WM. DENOVAN.

The Million Dollar Telescope.

To the Editor of the Scientific American:

Much has been said about this proposed instrument, and several plans given. I have another plan that, if it be not too visionary, will be far less expensive than and fully equal in its results to any other. I have read somewhere, or else I dreamed it, that if a plate of glass be placed over a circular opening and the air exhausted from behind it, the glass is bent back by the pressure of the atmosphere, and it may be made to retain this concavo-convex form. If this be true, why may not the lens be made in this way and filled with bisulphide of carbon? I see no reason why it may not, for all the glasses needed may be made of any convexity required Some genius can certainly work this out.

It has been proposed that the telescope be erected at Philadelphia, and that, during the exhibition of 1876, people be allowed to look through it at so much per head. This might do to raise money, and many would take the look just for the name of it, though very few would appreciate the sight. It requires a knowledge of such things and a taste for them to appreciate them properly. I have shown persons objects of the lesser world through the microscope; and though they considered themselves cultivated, they no more appreciated those beauties than would Lo, the poor Indian. There are many people, too, who are very fond of pictures; but after all, they do not appreciate them: they lack the knowledge of and taste for art. One may admire, and yet not appreciate. Thus it would be with the great telescope. While many might, from curiosity, want to gaze at the stars, the instrument would be doing mean service. Far better that it be placed at some point favorable for observation, and some experienced observer appointed to use it, and then we may expect it to do something worthy of so great an instrument.

I would willingly forego a look through it, much as I might desire it, that it might be used to better purpose. It is just the thing that I have thought of for years; if I were worth the million, I would have constructed it at my own expense for the benefit of science; but as I am worth less, I will have to stand back and wait awhile. Still, I hope the project will be carried out in some form.

Sans Souci, Ohio. X. PERRY MENTOR.

[Special Correspondence of the Scientific American.]

UP THE AMAZONS.

No. 1.

PARA.—ITS SITUATION, CLIMATE, INDUSTRY, AND COMMERCE.

The largest city on the largest river in the world, and the sole commercial outlet of a region equal to the United States east of the Mississippi but really more fertile: such is Pará.

It is a city of strange contrasts. Founded two hundred and fifty years ago and having an unparalleled position, it has to-day but thirty-five thousand inhabitants, a slow growth, due mainly to revolutions, yellow fever, and absurd legislation. Standing seventy miles from the ocean, it is nevertheless approachable by the largest steamers. It is built on a low tract of land, so that at a distance it appears, like Venice, seated on the sea, with beautiful rocinhas nestling in gardens along the shore, and every variety of craft, from frigate to canoe, on the water; hemmed in between the river Guajará and a perpetual forest that stubbornly disputes every inch of ground; with picturesque avenues of mongubas, graceful palms, and superb bananas in elegant luxuriance: with unpaved streets, neglected plazas, dilapidated houses, sombre churches with grass and shrubs growing on their tiled roofs; with screaming parrots and toothsome vultures, yellow dogs and chattering monkeys; with wealthy Brazilians in spotless white, noisy Portuguese porters, idle soldiers, merry negresses with trays or water jars on their heads, sober Indian women with naked children astride on their hips or rolling in the street; with a mongrel population of amalgamated Portuguese, Indian, and Negro blood—mulattos, Mamelucos, Cafuzos, Curibocos, and Xibaros; everywhere the signs of human indolence and Nature's thrift, of filth and poverty alongside of overpowering beauty and wealth of vegetation, yet altogether leaving a pleasing impression on the mind which can never fade.

Pará (officially called *Belém*—the Portuguese for Bethlehem), is justly celebrated for the almost perfect equilibrium of its climate. The temperature ranges from 73° to 93°, the mean of the year being 81°. The heat is never so oppressive as in New York, being tempered by strong sea breezes and afternoon showers. Were it not for the imported diseases, Pará would be the paradise of invalids. In 1819 the small pox first visited the city, in 1850 came the yellow fever; and in 1855, cholera. The natives suffer most from the first epidemic, and foreigners from the second. At the present time (July), the small pox is at work, not only in Pará, but also in Manáos, a thousand miles up the river. As

AGRICULTURE

is at a low ebb and import duties high, living is dear in comparison with former rates or with what we might expect in a city on the edge of an empire of exhaustless fertility. Luxuries are exorbitant. Hotels charge $2.50, gold, per day. Enterprise runs mainly to small shopkeeping and wholesale trade in rubber and cacao. But there is progress toward a better state of things. We notice many changes since our visit in 1867. The passport system was abolished last year. The State religion is more tolerant (the Jews have a synagogue), and religious holidays, which once seriously interfered with trade and industry, have been reduced in number. Among the new public buildings are the President's Palace and the Grand Opera House. The latter will cost $500,000, and contain a theater accommodating 1,600 persons and a saloon holding 1,200, in every respect out of all proportion to the wealth and size of the city. There are two banks, with a joint capital of $6,000,000. The city is lighted by a London company, the gas costing four dollars per thousand cubic feet. A circular railway now connects Pará and Nazareth, and is well patronized by high and low. The rolling stock consists of five locomotives, fourteen passenger and eight freight cars.

There are very few Germans, French, English, and Americans in Pará; but of Portuguese there are about 5,000, all busily coining money as shopkeepers, artizans, carmen, boatmen, etc. The native Brazilians are exceedingly jealous of them. They complain that these foreigners are monopolizing the trade of the country; but instead of vigorously competing with them, they threaten to drive them back to Portugal. While agriculture, such as it is, is carried on by the Tupuyos or civilized Indians, the mechanical arts are mainly in the hands of the Portuguese. Among the

INDUSTRIAL ESTABLISHMENTS,

there are fifty-nine bakers, forty-three tailors, thirty-six shoemakers, thirty-two carpenters and joiners, twenty barbers (including such as bleed by lancet and leech), nineteen tinners and glaziers, sixteen blacksmiths, thirteen butchers, ten printers, eight sugar refiners, eight soap and tallow chandlers, eight makers of fireworks, four dentists, four bookbinders, four confectioners, three photographers, three saddlers, three tanners, and three potters. No foreigner can practice a profession (as medicine or law), and charge for his services, without a certificate from the University at Rio. Dentistry, being considered a mechanical art, is allowed. There are at present sixteen printing presses at Pará, from which issue fourteen journals—five dailies, three semi-weeklies, and six weeklies; four bookstores; one college (*Lycéo Paraense*) with twelve departments: a normal school, having a course of three years; a library, museum, and literary club.

The great want of the country is laborers of all kinds, but especially field hands. Agriculture has been ruined by the universal rush into "extractive industry," that is, the collection of the natural products, as rubber, nuts, sarsaparilla, etc. The rubber trade absorbs supreme attention; sugar cane is grown for the manufacture of rum, sugar being imported from the southern provinces; and the cultivation of cotton, rice, coffee, and cacao along the Amazons is nearly neglected. Another check to commercial enterprises is the high and irregular tariff. The duty on imports varies from five to eighty per cent. Ordinarily it may be reckoned at forty; but the same goods will enter at different rates, evidently depending on the caprice of the official. Bribery is openly practiced and expected. The duty on ready-made clothing is determined by weight, and on shoes, by the length of the sole. The usual cost of exportation is seventeen per cent; but the loss is much greater on certain products, as cabinet woods. This practically discourages labor by taxing it. Not $400 were collected at the custom house on all the woods exported from Pará in 1868-9. Brazil abounds with the most valuable timber in the world, but is prevented from competing with other nations by this system of self-strangulation. There are but two or three saw mills on the Amazons. A dozen boards of the common wood of the country (cedar or itauba) costs eighteen dollars at Manáos. Fine rubber costs about fourteen dollars an arroba (32 lbs.) up the river, and the loss is about forty-five per cent in getting it to Liverpool or New York, half of which is for freight and the other half for custom charges.

But Pará is destined to enjoy an enviable rank among the commercial centers of the world. She can never have a rival at the mouth of the Amazons, for she occupies the only available spot, the northern channel between Macapá and Chaves being scarcely fit for navigation. Standing at the gateway of a magnificent valley covered with the richest and largest forests on the earth and at the *embouchure* of a river which affords an unparalleled extent of water communication, touching every country on the continent except Chili and Patagonia, Pará must become the

LIVERPOOL OF THE TROPICS.

Her most prominent citizens are men of progress, and the dead weights on trade and labor will soon be removed.

At present the commerce of a country of such vast extent and resources is ridiculously insignificant. As most of the articles of consumption are imported, and many of those produced are exported, the foreign trade is greatly in excess of the internal.

In 1872 the value of exports to England = $2,766,761; to the United States = $2,371,138; to France = $466,788; to Portugal = $247,222; to Germany = $38,438; to Southern Brazil = $171,469.

The greater part of the rubber goes to England and the United States (about 2,500 tuns to each); cacao goes chiefly to France; Brazil nuts, copauba oil, and tonka beans to the United States; straw hats, sarsaparilla, and tobacco to Southern Brazil; piassaba and fish glue to England; cotton, sugar, rice, farina, hides and cachaca to Portugal. During last year there entered the port of Pará twenty-four steamers and forty-nine sailing vessels (tunnage 62,393) bearing the stars and stripes; thirty-five English steamers and eighteen sailing vessels (tunnage 41,937); thirty-nine steamers and ten sailing vessels (tunnage 41,845) of the Empire; Portuguese sailing craft, twenty three; French, nineteen; and from other nations sixteen. The total value of exports from Pará in 1871 was $6,710,561, of which $5,323,135 belong to rubber.

In my next I will treat of the navigation and commercial resources of the Amazons. JAMES ORTON.

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LETTER FROM UNITED STATES COMMISSIONER PROFESSOR R. H. THURSTON.

NUMBER 13.

BERLIN, September, 1873.

Leaving Vienna late in the evening by express train, the traveller may reach Dresden next morning. The route tra verses a pleasant country, but no objects of remarkable interest are seen until, not far from the end of the journey, the little town of Bodenbach is reached. Here our baggage is examined by the customs' officials with equal courtesy and care; we get our breakfast and move on. Here we enter the

SAXON SWITZERLAND,

and as we rapidly ride along the banks of the Elbe, we admire the beautiful mountain scenery on either hand, with high rugged cliffs, bordering the river or confining the narrow lateral valleys with their tangled linings of green foliage, the dark ravines and picturesque basaltic peaks and jutting promontories, the remarkable natural bridge at the Bastei, and the lofty hights of these immense rocks, the *Lilienstein* and the *Königstein*. The latter is crowned with the once impregnable fortress which defied, in earlier times, the attempt of the "Conqueror of Europe" to breach its walls from the hights of Lilienstein. The strange forms assumed by the basalt produce quaint and striking views all along the whole distance; from the crossing of the Elbe at Bodenbach nearly to Dresden, these views form an uninterrupted succession of most beautiful panoramas. The river itself presents objects alike novel and interesting. Here and there, anchored in the stream, are queer *schiffmühle*, large scows or rafts carrying mills for grinding grain, and deriving power from the action of large paddle wheels which are turned by the rapid current. Towage is performed by a steamer which is destitute of paddle wheels, screw propeller or oars. It is a *Kette-dämpf* or chain steamer, which propels itself and draws after it a heavy "tow" by overhauling a strong iron chain which is laid along the bed of the river, and which, coming on board at the bow, passes around a drum amidships and overboard again at stern. So far as expenditure of power is concerned, this is the most economical of methods of propulsion, and the apparent ease with which these vessels are steered and manœuvered is quite surprising. It is somewhat remarkable that this method, which has been long known and practiced in this country, and of which the economy is well understood by all engineers, has been so little used in America, where we have so many locations to which it would be most suitable. The objections to its use in other places would probably be found to be the expense of the chain on long routes, and the fact that the craft is confined to a precise line of travel from which it cannot depart to meet the exigencies of wind or tide, or to avoid other vessels. By this system loss from "slip," which amounts, in ordinary propulsion and towage, to from ten to fifty per cent of the total power expended, is entirely avoided.

Plying on the river are also many little passenger steamers, conveying excursionists to and from the many beautiful watering places and romantic little villages which are scattered along either bank. "Beautiful little boats," the guide books call them, but they look far more quaint and antiquated than beautiful to the traveler who has traversed Long Island Sound, or who has sailed upon the Hudson or upon the Mississippi.

Leaving the river bank, we approach Dresden, crossing a level fertile plain, and are soon landed in this Saxon capital. Dresden has always been a favorite residence both with Americans and with English people, who find here cheap living, good music, a noble gallery of paintings, and good schools for their children. The beautiful suburbs of the town afford pleasant excursions and beautiful drives in summer; and in winter, music, the theater, and skating make the time pass very pleasantly.

At the earliest possible moment we visited the

POLYTECHNIC SCHOOL,

which is one of the oldest and best in Europe, although not very well provided with models and illustrative apparatus in its technical departments. Some of the work done by the students is remarkably fine. One had planned and made the drawings of waterworks for supplying a large town, another had completed the specifications and designs of a peculiar form of steam engine, a third had planned a cotton mill, and a fourth had prepared designs for an ironworks. The amount of time given to the work in the drawing room, is, however, exceptionally great. The student is usually engaged in this work sixteen hours per week, beside which he attends to studies and the lectures given in the several collegiate departments. In some instances, the designs produced by the students exhibited considerable inventive talent; and, in the majority of instances, the plans were well chosen and the details were well proportioned. The young men who, having had the advantages of such instruction, have sufficient energy and love of their profession to enter the workshop, and there learn the no less important details of shop practice, cannot fail to succeed in life, even in Germany, where good opportunities are so much more infrequent than with us.

We found time to visit the

GREAT PICTURE GALLERY

for which Dresden is noted, and there saw the noble works of Correggio and of Rubens, of Rembrandt and Titian, and of dozens of other famous painters of early and of later times, and finally stood, in silent, wondering admiration, before the noblest of them all, Raffaelle's *Madonna di San Sisto*. We passed hastily through the *Grüne Gewolbe* (the green vaults), examining curiously and hurriedly the wealth of art treasures preserved there.

We wandered through the pleasant streets, enjoyed a ride through the lovely *Grosse Garten* and, still more, our visit to the great library, where, among its 800,000 volumes, we found many referring to the early history of our own country. We should have been glad to have spent much more time here, but duty forbade, and we hastened on to Berlin, after taking a day to visit the famous old town and the celebrated

MINING SCHOOL OF FREIBERG,

the *Berg-Academie*. Here we found a good collection of models of mining apparatus and machinery, and a considerable number of newly made duplicates, which, we were pleased to learn, were made for some of our own schools in the United States.

Freiberg is situated in the midst of a mining country, and the exceptional advantages which the school is enabled to offer to students, in consequence of this fact, together with the high character of its professors, have given it a celebrity second probably to none other in the world. A large number of young men from the United States have been educated here. To-day, fortunately, there is no necessity for the American student of mining to leave our country to secure his professional education. The town appears to the stranger curiously antiquated, and the people sometimes almost equally so. The picturesque costume of some of the women, consisting of a red hat and a blue gown, or of a blue head covering and apron with a red petticoat, by its strong contrast of colors, is quite striking and pleasing.

The great city of Berlin has many attractions for the tourist, although it bears no comparison with either London or Paris. Its noble buildings and fine wide streets, its palaces and gardens, and its museums, are exceptionally interesting and pleasing. To us, as to the ordinary visitor, they presented unusual attractions, and the limited time that was allowed for their inspection was enjoyed greatly. But even more interesting than the palaces was the great

LOCOMOTIVE WORKS OF BORSIG,

and the two technical schools—the *Bau-Academie* and the *Gewerbe-Schule*—were not less interesting than the museums.

Borsig's works are among the most important in Germany, as may be seen from the fact that of the 5,455 locomotives reported as belonging to the German railroads in 1870, more than 1,900 were built at this establishment. Only the locomotive works are in Berlin. The iron and steel is made at the large ironworks near the mines, and the boiler shops and forges are at Moabit, a little way from Berlin.

In 1870 the *Borsigsche Anstalt*, in the city, made 158 locomotives. Its capacity is now 170 per year. The *Gesellschaft für Fabrication von Eisenbahnbedarf* in the same year turned out 2,522 railroad cars, valued at three and a half millions of thalers. The ironworks at Moabit in that year worked up 107,609 centners of iron. The locomotive works now employ from 1,500 to 1,800 men, who work eleven hours per day and receive from ten to fourteen thalers—5 to 7 dollars—per week in wages. A restaurant and dining hall have been erected on the premises, and a large number of the workmen avail themselves of the privilege thus offered of taking their meals at the works. The buildings and tools are generally old; but additional buildings are in course of erection, and modern tools are to be placed in them. Ample light, and that usually from above, and good ventilation, the points in which old establishments are invariably defective, are well looked to here; and those most invaluable of all tools in shops doing heavy work, traveling cranes, are not forgotten and are well placed.

A few new tools were already in, and among them was a fine tool, imported from England, for the especial work of trimming up engine frames, which here, as in all European locomotive works, are cut from rolled plates. The machine has four tool posts, feeds in every direction, and the position of the cutting tool may be altered to suit the work. The locomotive frames are cut from plates thirty millimeters—one and two tenths inches—in thickness. Tender frames are of lighter plate, ten millimeters thick. Fire boxes are invariably of copper, and the tubes are of copper at and near the firebox end, the main portion being of iron. Some of the tubes are English, and some are from Düsseldorf.

FORGED WHEELS.

Here, as all over Europe, all wheels are forged. A cast iron wheel, whether for cars or for locomotives, would be looked upon here with equal curiosity and distrust.

We were much interested, at Moabit, in witnessing the process of forging these wheels. Each arm is first forged separately, with its proportional part of hub and rim attached. These several pieces are next welded together to form the rough wheel, and, on each side of the thin hub thus formed by the union of the inner ends of the arms, is then welded an iron ring, making the wheel complete and ready for finishing in the machine shop. This makes an excellent and thoroughly reliable, but an expensive, wheel. Large fires and heavy steam hammers are employed in this work. There are twenty steam hammers in the forge shops. There was but little that was noteworthy in the

BOILER SHOP.

There were no steam riveting machines visible. The riveting was done by hand, but not as is usual in American practice. The rivet holes were punched a quarter inch or more smaller than the intended finished size, and were then drilled out to the full size. The rivets were roughly headed with the common light hammer and were then given their proper form—the snap head—with a die driven by heavy hammers. In some cases the lighter hammer was entirely dispensed with. This makes a good job, and, particularly for heavy plate and large rivets, is probably much superior to the riveting so universally used with us. The conical head is not nearly as strong as the snap head, and it is far more liable to be injured by cold hammering in giving a finish. Where the strain upon the rivet is longitudinal, as where the braces are riveted to the shell, this difference is of great importance.

Like nearly all great establishments, this has grown up from very small beginnings. The first locomotive was turned out in 1841, and to-day the total number has exceeded 3,100. This prosperous growth has apparently been due to the energy, skill, and enterprise of one man, Borsig, its founder, and, in no small degree, to his exceptional interest in the welfare of his workmen, who learned to look upon him as a friend as well as an employer, and who felt a confidence in his regard for them which was never betrayed. Whether this trait in his character was a phase of simple benevolence, or was merely an evidence of his appreciation of the often forgotten axiom that "the real interests of employers and employed are identical," matters little. It probably came of both. The result has been the founding of a great establishment, and the founder has earned a most enviable name. A large wreath-crowned bust of this great man, who is now dead, is mounted at one end of the great dining hall of the locomotive works, and along the walls are suspended pictures of his most remarkable productions. Flags which bear legends, referring to celebrations of important events in the history of the establishment, are suspended above them, reminding the visitor of the display of battle flags in the Tower of London, or of the relics of our own sad civil war. These are trophies of a far more pleasing kind. At the

BAU-ACADEMIE AND THE GEWERBE-SCHULE

there is much to interest those who are engaged in this branch of education, yet not much that can be given here. The former has 650 students and has no room for more. There are 58 instructors. The model rooms contain some unusually fine models of bridges and a large collection of architectural and other models in plaster. The lecture rooms are quite well arranged, but do not compare favorably with those of many colleges in the United States.

The *Gewerbe-Schule* is more a school of engineering, and is one of the best in Europe. The buildings are very large and are quite well arranged; the lecture rooms are unusually well fitted up, and the collection of models and of illustrative apparatus is probably the best in the country. Several workmen are kept at work, in a machine shop attached to the school, making new models; and such students as desire to do so, and at the same time exhibit special talent, are permitted to work in the shop under instruction. The collections are thus continually growing, and the school, under the administration of Professor Reuleaux and his large corps of assistants, is doing a great and a good work.

After making valuable additions to our memoranda, both educational and technical, and paying a hurried visit to a few of the many attractions of Berlin, and after spending a pleasant hour with the distinguished historian and diplomat who so ably represents the United States at the Prussian capital, we reluctantly left our pleasant lodgings *Unter den Linden*, and started westward *viâ* Cologne and the magnificent valley of the Rhine.

R. H. T.

Lard as an Unguent.

It is well known that rubbing the body with hog's fat has the effect of reducing the temperature of the skin in scarlet fever. A gentleman of our acquaintance has used the fat portion of smoked ham with beneficial results, and writes to the editor to disseminate the fact for others' benefit. A celebrated German physician recommends to incorporate one or two grammes of carbolic acid into one hundred grammes of lard, and, with this, to rub the whole body, excepting the head, two or three times a day, according to the intensity of inflammation characterizing the case in hand. The effect of this kind of treatment is to produce a pleasant feeling of coolness, to keep the skin softer, and after each application the temperature of the skin falls somewhat. The carbolic acid operates to destroy the germs and spores of the disease.

Packing Oranges and Lemons.

A full grown orange tree yields from 500 to 2,000 fruit annually, and arrives at the bearing state in three or five years, as does the lemon tree; both grow luxuriantly in most soils. The plantations (in the Mediterranean countries) are called gardens, and vary in size, the smallest containing only a small number of trees, and the largest many thousands. The fruit is gathered in baskets similar to peach baskets, lined with canvas, the basket being held by a strap attached and passed around the neck or shoulders. From the garden the fruit goes to the repacking magazine, where it is removed from the boxes, in which it was packed in the gardens, and repacked for shipment by experienced female packers, after having been carefully assorted by women, and wrapped in separate papers by young girls. As many as 500 persons (mostly women and children) are employed by some of the fruit growers in their gardens and magazines, in gathering, sorting, and repacking for shipment, the wages paid them varying from nine to sixteen cents a day. In sorting, every fruit that wants a stem is rejected. The boxes are then securely covered, strapped, and marked with the brand of the grower, when they are ready for shipment. Twenty years ago, this trade was nothing in its commercial characteristics, or the inducements it offered to capitalists. Now it is progressing with giant strides into prominence, and is a considerable source of revenue to the government.

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COMBINED HAY RAKE AND TEDDER.

The principal part of this device, an engraving of which is herewith given, is the tedder, which consists of a novel arrangement of a three-throw crank with sliding forks. The latter are actuated in a manner closely imitative of the motion of the arms of a person in handling a pitchfork to toss the hay, for the purpose of admitting a free circulation of the air through the same and thus causing it to be properly cured before removal from the field. The balance of the invention is a very easy and expeditious manner of converting the tedder frame into an improved horse rake

The oblong frame, which forms the truck, is mounted on wheels and provided with keepers which adapt it for the introduction of a pole or shafts so that the machine may be used with one or two horses, as desired. There is a suitable seat and foot board near each extremity of the axle, A, and inside the main wheels are attached cog wheels, B, which engage with pinions, C. The latter connect with the crank shafts, D. These shafts, as above intimated, are an arrangement of the crank in threefold relation, twice duplicated, and consist of two separate parts, the inner ends of which may meet in a hinged box, H, or be simply inserted in a suitable bearing on the central beam of the frame. E are the fork stems which, six on each shaft, are bent around and embrace the crank rod between shoulders or flanges on the same. Between the parallel parts of the stems, and next to the cranks, are arranged elastic boxes or shifting bearings for the crank connection, so as to relieve the same from sudden strain, and adapt it to the free motion of the forks. The latter are shown in the engraving in two forms; those marked F are spring forks, the tines of which are coiled to form eyes, through which and a hole near the end of the stem, bolts pass. This, with the bows of the tines, being slipped over open slots, also in the stems, secures the parts quickly and firmly together. This fork is well adapted for light grass. For heavier work, however, ordinary forks, G, are dovetailed by short shanks to the stems and secured by headed screw bolts.

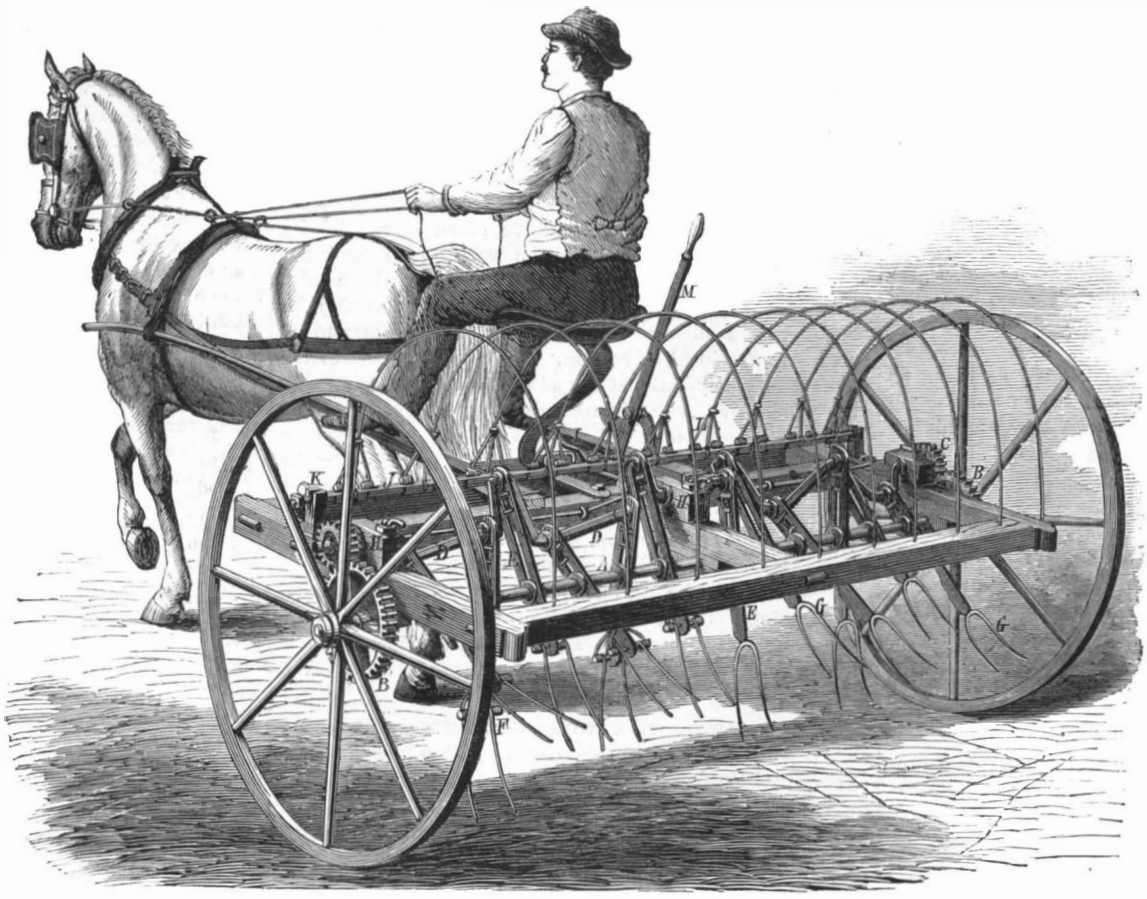
Returning to the crank shafts, D, it will be observed that their outer ends are held in hinged boxes, also marked H. Near the extremities are arranged radial pins which, in connection with loose clutches united with the pinions, C, bring the latter in gear with the cogged wheels, B. A rod or wire between clutch and pinion is led through keepers to a lever, I, placed conveniently to the foot of the driver, so that, by moving the bar in either way, one or both of the sets of forks may be thrown into or out of action. The collars or flanges, shown on the axle, A, serve as guides to the stems in their sliding movement caused by the cranks.

Our artist shows the tedder in action, and the rake also attached to the machine, but out of use. In order to put the rake in operation the tedder must first be removed, an easy proceeding, as the crank bars are quickly lifted from the hinged boxes, H, and the forked stems slipped off the axle. The hay rake bar, J, fits in permanent bearings, K, placed on each side of and centrally on the frame pieces. The tines or teeth are independent in their motions on the shaft and are held thereon between shoulders. Spring braces, L, bear upon every tine, so that if one be raised the others are not affected. A hand lever, M, connects with the shaft and serves as a convenient means for raising and discharging the rake. In connection with the same appliance is a foot piece, which, when pressed down and brought under a lug, keeps the rake in an elevated position when not in use.

The reader will, before this, have noted that this device is not complicated, and that it furnishes, in one apparatus, two very useful machines. Its width is about that of the ordinary horse rake. From an examination of the model, we should judge it to be a machine well worthy of the attention of agriculturists. It has the merit of being a very neat mechanical device for producing an out-of-the-way motion with an unusually small quantity of gearing, a point of importance when considered in connection with the innumerable cogs, racks, pinions and other devices, which too often encumber agricultural machinery for even the simplest purposes.

The inventor is Mr. R. J. Colvin, of Lancaster, Pa., and the date of the patent is April 22, 1873.

Further particulars may be obtained by addressing the present owner of the invention, Mr. M. T. Boyer, of Parksburgh, Pa.



COLVIN'S COMBINED HAY RAKE AND TEDDER.

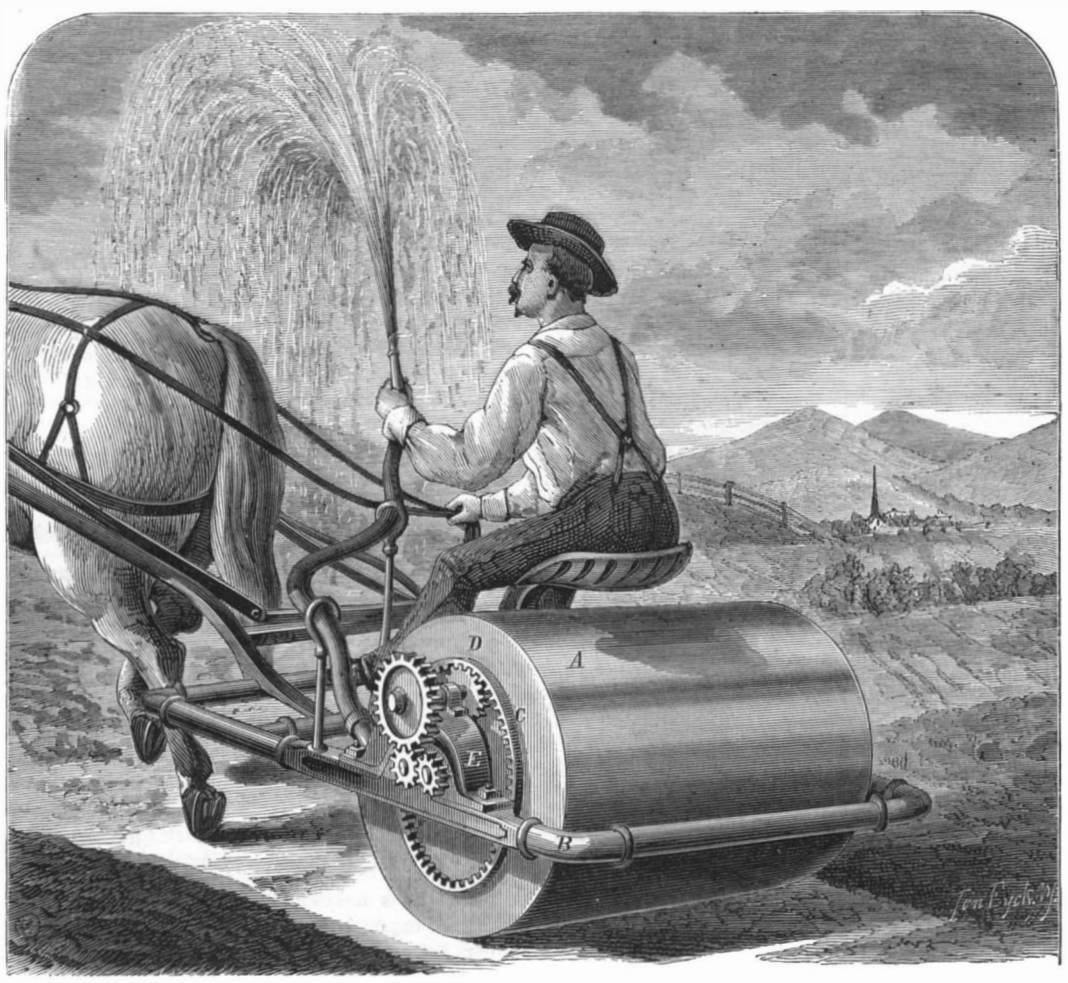
IMPROVED COMBINED ROLLER AND IRRIGATOR.

The combined roller and irrigator, represented in our illustration, unites, in obvious utility, two sources of success to industrious husbandry—the preparation and proper irrigation of the soil. It is quite simple in construction, so that but a brief description of its parts (as indicated by letters in the illustration) is necessary. A is a hollow drum of wrought or cast iron, so arranged in the frame, B, which is made of hollow tubing, as to revolve on hollow watertight bearings at one or both ends. It also has a gear flange, C, attached to either end, the teeth of which engage with a pinion at D, which, in turn, gives motion to any suitably arranged gearing, to impart proper speed to the pump, E, attached to the frame, B, over one of the bearings of the roller, A. When the machine is drawn over the ground, the roller, rotating, communicates its motion to the pump, which ejects, with any required force, the fluid contents of the cylinder with which it has been previously filled; air is supplied through the opposite bearing to satisfy the vacuum. A lever, actuated by the foot of the operator, and not shown in the engraving, serves to disconnect the pump gearing, when the services of the roller alone are desired.

The present engraving illustrates one of the simplest and cheapest forms in which this machine is constructed. It is built of any desired capacity, from the hand garden roller of the horticulturist to the largest and heaviest of machines operated by steam for the rolling and sprinkling of streets. One form of construction confines all the machinery within the drum, pendant from a tubular, shaft in the center of the roller longitudinally. In this arrangement the fluid is forced through the shaft into the frame, which is also tubular as well as the drawing attachments, a hose being attached to any convenient point. In the more expensive forms of construction it is considered an advantage to build the machine entirely of iron, constructing the frame of piping, as well for the additional strength and beauty of form as for the added water space and utility.

By using this machine, it is claimed, liquid manures are made more cheaply and readily available. In the distribution of all fluids by this irrigator, the liquid is thrown high in the air and falls in fine rain or spray over the surface. As a roller it possesses the same advantages as any ordinary land roller, being adjustable in weight, and that weight being in the best position to be most out of the way and most advantageously applied.

Patented June 17, 1873. For further particulars address the inventor, Mr. Dean S. Howard, Drewry's Bluff, Chesterfield county, Va.



HOWARD'S COMBINED ROLLER AND IRRIGATOR.

Burning Coal Beds.

The so called "burning mountain" at Dudweiler, in the district of Saarbrück, which has been an object of interest to tourists and men of science for more than a century, is now shorn of its attractions; to the former it presents the spectacle of what is, at best, but a smoking mountain; to the latter it is a mere impostor, since, instead of being, as was supposed by earlier scientific observers, a display of volcanic action, or a proof of central fires, it is now clearly established as the result of the spontaneous combustion of a stratum of coal. These smoldering fires, produced by some change which takes place in constituents of the coal may, indeed, burn with more or less intensity for centuries. The thought of such waste is peculiarly distressing at the present time, and the burning mountain of Dudweiler shows only common good feeling by mitigating its destructive proceedings at this crisis. A coal bed at Niederplanitz, near Zwickau, in Saxony, has been burning in a similar manner between 300 and 400 years. The heat given out by this subterranean fire, at a cost which it is distressing to calculate, is not wholly wasted. An ingenious person, since dead, has established a magnificent nursery ground on the burning area, in which, by means of a system of pipes, the supply of caloric is regulated and applied at will. Tropical plants flourish here in the open air with a luxuriance which the best forcing houses and conservatories cannot insure.—*Mining Journal.*

[Passing through the coal region of Pennsylvania, not long ago, we saw smoke issuing from a mountain in the distance, which, we were told, had been burning for more than a quarter of a century; and that a great deal of money had been expended in the attempt to sever the coal vein and conduct water into the seams to extinguish the fire, but without success.—EDS.]

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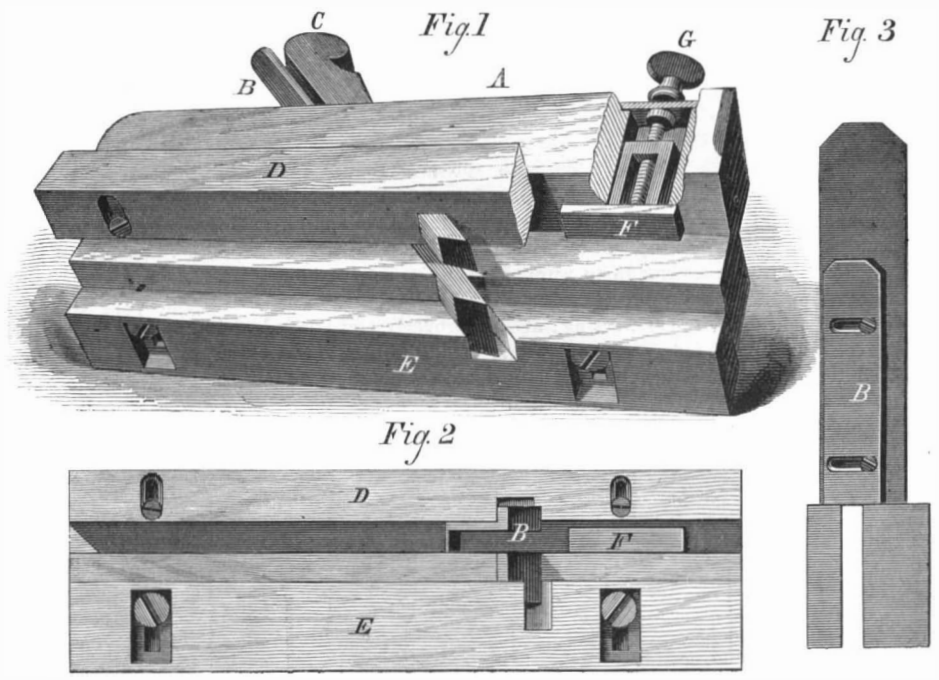
IMPROVED MATCH PLANE.

We illustrate herewith one of those ingenious devices which in a single instrument combines the capabilities of a variety of tools. It consists in a match plane which, by suitable adjustments of its parts, may be set to tongue boards of any thickness.

A is the main stock, B is the iron, and C the key, shown in the side view, Fig. 1. The face of the tool, Fig. 2, is formed in two parts, one of which is an adjustable piece, D, which, fitting into a rabbet of the stock, is made adjustable laterally thereon by screws passing through slots, as shown. By moving this piece out or in, the length of the mouth of the tool is varied so as to correspond with the width of the adjustable iron, B. The latter, Fig. 3, is made in two portions, also connected by screws and slots so that the space between the cutting edges may be made broad or narrow to receive the tongue, which is cut of corresponding size.

E, Fig. 2, is a guide adjustable on the face of the tool by the same means as above described, and F is a gage operated by the thumbscrew, G, for regulating the depth of the cut. Any ordinary plow iron may be used in the grooving tool, and the tonguing tool may be adjusted to suit the groove. With a single pair of implements therefore, it is claimed, the operator is enabled to perform work which ordinarily calls for the use of a multiplicity of devices, thus saving much expense and trouble. Patented through the Scientific American Patent Agency, June 10, 1873, by Mr. James Edwards, of No. 323 Fifth avenue, Brooklyn, N. Y., from whom further particulars regarding sale of patents or State rights may be obtained.



EDWARDS' MATCH PLANE.

THE GLOBE STEAM GAGE.

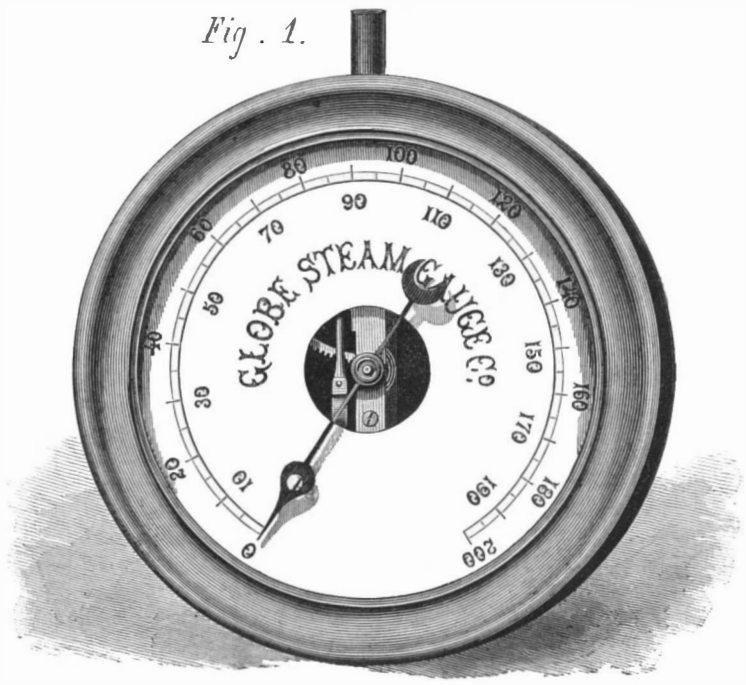
The amount of correspondence concerning boiler explosions, which has been lately published in scientific journals points out the importance of a trustworthy pressure indicator, which can be relied on, at all times, to show any variation in the force within the boiler, and to indicate the same accurately after long continued use.

The invention which we illustrate herewith is a steam gage of quite simple construction, which we are informed has been in use on the Erie railroad for four years past, during which period it has not varied one pound from the test gage with which it was first compared. Various certificates from railroad officials and others, submitted to us by the owners of the patent, speak highly in recommendation of the instrument, so that it may be fairly considered as having successfully withstood the test of actual experience.

Fig. 1 gives the appearance of the dial of the apparatus, and Fig. 2 a section showing the essential portions. A is the case, and B a metal spring, the space, C, in rear of which contains water. Steam enters from a pipe at D, and presses the spring inwards into the position of the dotted line. The motion of the spring, by suitable lever and other mechanism, is transmitted to the dial needle which registers the pressure in accordance with the amount the spring is driven inward. The instrument is very sensitive and accurate; and it is claimed that it will withstand a heavy pressure without the spring becoming permanently set, and also that at 140 lbs. pressure the spring is forced out from the center $\frac{1}{8}$ of an inch. Under a pressure of 700 lbs., to which the apparatus was subjected a short time since, at the manufactory in Waterbury, Conn., the spring was reversed in form and blown out, falling some ten feet distant.

It is further stated that the gage does not get out of order, and that when in use upon a locomotive there is no vibration or trembling of the pointer, no matter how high the speed at which the engine may be running.

For further information, address Messrs. Austin M. Hayward & Son, Susquehanna Depot, Pa.



THE GLOBE STEAM GAGE.

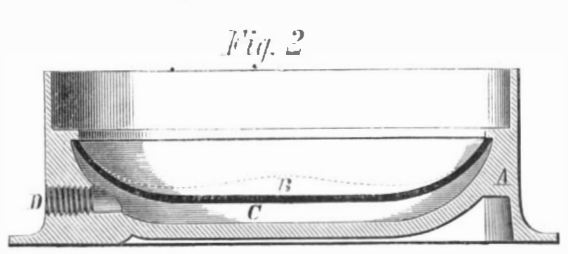
Test for Copper and Tin in Extracts.

The poisonous nature of copper, and, to a less degree, of tin, makes the following method of testing for them in an extract, as described by Hager, both interesting and useful, for either of these metals may have been dissolved from the walls of the vessel in which it was prepared. "The extract is, for this purpose, dissolved in five parts of water, or very dilute spirits, and slightly acidified with a drop or two of hydrochloric acid. A bright strip of zinc is placed in the solution, and, after half an hour, if no impurities are present, the zinc will be found as bright and colorless as when first put in. If, however, copper and tin are present, it will be coated with brown film; if tin alone is present, the film will have a grayish white color. It is washed with water and dried by heating the strip of zinc gently in an alcohol flame, and the copper will be indicated by its well known copper color. Under like conditions the film of tin is a dull grayish white. If copper and tin are both present, and it is desired to determine the quantity of the tin, the film is peeled off with a knife into a test glass and 5 to 8 drops nitric acid added. It is carefully boiled until entirely dissolved, when 75 drops ammonia is added, the solution shaken and allowed to settle. If tin is present, it will separate as amorphous oxide of tin in white flakes." We venture the suggestion that lead can be determined in a similar manner by precipitating on zinc.

Mineral Oils for Iron.

The use of heavy mineral oil as a preservative for iron is strongly recommended by the *London Oil Trade Review*, the substance referred to being, we presume, one of the products of shale distillation, so extensively practiced in Great Britain. Whether a similar product can be obtained from our petroleums is a good subject for research. Our cotemporary says:

The action of the oil is twofold. First, it is detergent when vigorously and freely brushed over an already rusted surface. It seems to loosen the bulk of the rust and it darkens that which remains. Secondly, it acts as a varnish if applied after the cleansing has been effected, or to new and bright work. Its superiority to vegetable or animal oils depends upon the fact that the bulk of the oil evaporates, and it leaves only a very fine film behind. If the oil is light and fully refined, it evaporates so completely as to do but little good in this way; but if tinged or "once run" oil of sufficiently high gravity be used, the resinous or carbonaceous matter which gives the tinge to the oil remains behind and forms the thin protecting film of varnish. Ordinary varnish leaves far too thick and obvious a film, while the film of the once run oil does its work of protection without displaying itself. As regards the density of the oil required for this purpose, we recommend that which stands between the burning oil and good lubricating oil; it is known, and sometimes sold, as "intermediate oil." We are satisfied that a good trade may be done by anybody who will bring this before the public in a proper manner, and supply the article as required. For domestic purposes, for the cleaning of all kinds of household iron work, for the preservation of such things as mowing machines and other garden tools or exposed iron implements, the brown oil should be sold in small bottles at a cheap rate. For manufacturers of iron work and for ironmongers, to whom it will prove invaluable, it must of course be supplied in larger parcels. At present it can hardly be used at all, on account of the difficulty of obtaining it in retail quantities.



Ruled Test Plates for the Microscope.

In a recent paper read before the Quekett Microscopical Club, London, Mr. William Webb takes the ground that the alleged ruled plates of Nobert and others, purporting to present 200,000 lines to the inch, are illusions, it being a physical impossibility to cut any such number of distinct lines within such limits. He says:

That a micrometer with the lines the one 200-thousandth of an inch apart ruled on glass is an absolute impossibility. That if it be possible to rule lines themselves of the width of the one 200-thousandth of an inch, to make them definable there must be a clearly defined line between them, and a clearly defined line in the same plane of observation. That beyond the first few coarse bands of M. Nobert's tests, there is not, properly so called, a single line. That in the finest bands, except at their extreme sides, there is not half a line. That in the finest bands the only thing certain, except the edges, is the uncertain polarized aerial lines. That the microscopical world has been pursuing a phantom, and adopting a fallacy. That polarization of light in the examination of these and analagous tests is a deceitful servant of the microscopist.

That oblique illumination is another deceiver. That if M. Nobert were to attempt to fill his incisions with black, his finest bands would be merged each into one black line of the breadth of each particular band. That a test must be a known thing which some power will either disperse or fail to define, as in the case of a spectacle vendor, who places before an intending purchaser's eyes words printed in types of different sorts as a known test of visual powers. That there are no tests so reliable as a known measured congeries of contorted lines, as in microscopic writings, where the transmitted rays are partially shut off by the black, and in which, the rays transmitted being transmitted by direct illumination, their definition is not interfered with; such rays becoming parallel rays, passing out at right angles with the surface of the glass, the unalterable law of natural optics being that the angle of incidence and the angle of reflection are equal.

The Cincinnati Exposition.

The second Annual Exposition held in Cincinnati is now in progress, and attracting, on an average, some 12,000 visitors per day. We learn that it is the finest and largest display yet made in the West, and fully in accordance with what might be expected from a city inferior, in point of number and variety of its manufactures, only to New York and Philadelphia. Cincinnati alone furnishes one half the steam engines on exhibition, besides a fair proportion of the agricultural and labor-saving machines. There is also a large display of furniture of fine workmanship, coming from the various establishments of the city. Stoves occupy a prominent place in the list of local products; and from the manufacture, it seems probable that Cincinnati may fairly rival Troy and Pittsburgh. The makers of boots and shoes also carry on an extensive business, employing the most approved machinery and selling goods at the rate of $2,250,000 per year. Miscellaneous goods, and also leather, are exhibited in profusion. Of the latter the city makers, last year, produced $2,473,800 worth. There are from twenty to thirty different kinds of carriages displayed, the workmanship of which compares favorably with that of the best eastern firms. Pork packing is of course represented on a large scale. The figures of the past two years show a marked increase in this important trade. During the winter of 1870–71, there were packed 481,560 hogs, and in the succeeding winter, 630,301.

The Exposition is drawing large numbers of the country people to the city, and the attendance appears to be increasing in spite of the rival attractions of the Louisville Fair.

J. W. S. writes to say that he has a perpetual motion in running order, and he will dispose of it for $2,000,000 for a "plot;" but if he has to carry it to Washington, he will ask $5,000,000. The existing financial crisis will, we fear, prevent our correspondent from receiving either of the sums he mentions.

DURING last autumn, says the *Journal of the Society of Arts*, there were no less than seventeen companies extracting gold from the auriferous sand of Finland. One of the companies returned a dividend of 70 per cent. The largest nugget weighed 28 pennyweights.

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Printing with Aniline Black.

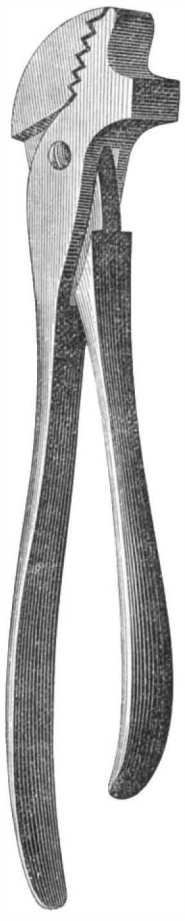
When ammonia is added in excess to a solution of alum, a gelatinous precipitate is formed which consists of the hydrated oxide of aluminum. This hydrate is soluble in acids, acting in that case as a base, but it is also soluble in caustic soda and potash, when it acts as a weak acid and forms salts known as aluminates of soda and potash. The aluminate of soda can be prepared very cheaply, and is advantageously employed, according to Dr. A. Kielmeyer, for coating the cloth placed under the calico and running along with it. In calico printing a portion, of course, of the color or mordant employed passes entirely through the cloth which is being printed; and to prevent it from being deposited on the pressure rollers and returned to a clean part of the cloth upon the second revolution, it is customary to have a piece of thick woolen cloth (a little wider than the calico, running between the calico and roller to take up this excess) and to pass it over one of the heated cylinders; it is thus dried and can be used two or three times before it has to be cleaned. The great expense of these "travellers" and the labor of cleaning them has induced several calico printers to substitute a piece of the unbleached cotton cloth. After being used once it can be bleached and is in no way injured for calico, except in one particular case. A piece of unbleached muslin which has been soiled by aniline black cannot be entirely cleaned by the bleaching process, and, moreover, the fiber is injured. For this reason it has been necessary to adhere to the old method of expensive woolen "travellers" when using aniline black.

Dr. Kielmeyer has, however, made the interesting discovery that aluminate of soda mixed with scorched starch prevents the aniline black from attaching itself to the cotton. The alkalinity of this substance prevents the black from being developed; and at the same time, the solid hydrate of alumina is formed where aniline black and aluminate of soda come in contact, and protects the fiber by preventing the black from coming in contact with it. Attempts to employ the carbonate and acetate of alumina for the same purpose have not succeeded well; for although they check the development of the black, they do not form that insoluble layer which protects the fiber.

In preparing the goods, the unbleached muslin, as soon as it is singed, is passed twice through a cold solution of aluminate of soda of 4 or 5° B. It is left unrolled for two hours that it may become evenly distributed throughout the goods, and then dried on the hot cylinders. The cost of material for preparing a piece 164 feet in length is, in Germany, about 4 cents. For light patterns, like shirtings, it can be used over two or three times, for heavier ones but once; and if the pattern is very heavy, a solution of 10° B. should be employed. Before proceeding to bleach them, they are placed in a muriatic acid solution of 2° B. and washed. After bleaching there will be no trace left of the black. It has also been observed that the black patterns printed over this background do not strike through the goods so much as otherwise, and consequently the fabrics are not weakened so much; but upon the right side they are perfectly bright and full. Even this latter is of no small account when we remember that all aniline black, if never so carefully prepared, has more or less tendency to rot or weaken the fiber.

IMPROVED SHOEMAKER'S PINCHERS.

Mr. William H. Hanna, of Chico, Butte county, California, has recently patented, through the Scientific American Patent Agency, an improved form of shoemaker's pinchers, an engraving of which we herewith present.



It will be observed that the distance between the ends of the jaws and the pivot is considerably shortened, so as to secure greater power of grip. For the same purpose, the lever is extended beyond the extremity of the handle. On the under side of the lever is made a projection, so that the jaws act as a fulcrum against the last and thus preserve as large a range of movement as can be afforded with the ordinary instruments with much longer jaws. The upper lever is placed in about the same plane as the jaws, so that the line of draft coincides with the lever, and the lower handle does not come in contact with the last, as is commonly the case before the leather is sufficiently strained. The teeth abut against the turning face of the jaws so as to bring the bite near to the pivot, thus enabling the upper to be drawn as close as is desirable to the last. It is stated that there is no slipping off of the tool in cases of unusual strain and it is not liable to tear the leather or hurt the hand. Patented July 22, 1873. Further particulars will be found in the advertising columns of our present issue.

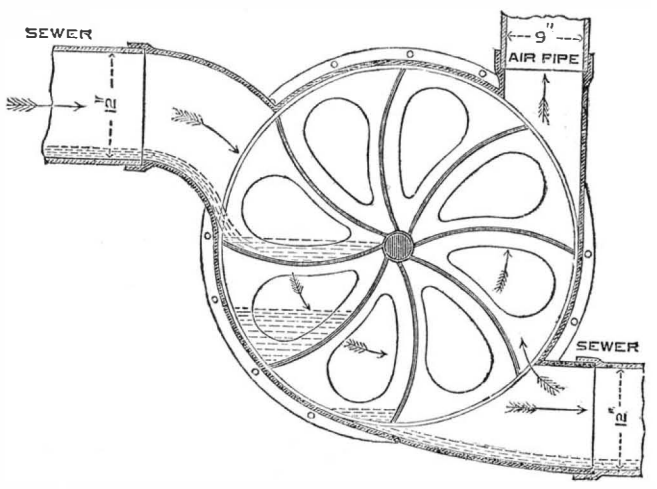
A Check to Railway Enterprises.

Among the bad effects of the recent financial crisis is the cessation of work upon unfinished railways and railway machinery in various parts of the country. Many thousands of laboring men have been suddenly thrown out of employment, and a winter of suffering appears likely to overtake hundreds of worthy families.

As an example of the mischief wrought by this unfortunate state of things, we may mention that the orders for locomotives at the Rogers works, Paterson, N. J., have been canceled and 600 men have been discharged. It is supposed that the principal locomotive shops will soon discharge several thousand men in the aggregate.

VENTILATION OF SEWERS.

The annexed diagram represents one of a series of fans placed in the line of a sewer, with an air pipe from it, supposed to be in connection with the atmosphere above the houses. It is the design of Mr. John Phillips, given in the *Builder*. By causing the sewage to fall into the fans on one side near the top and to escape on the other side at the bottom, they are made to rotate, draw air out of the sewer, and force it up the pipes into the atmosphere. The fans, therefore, are self-acting; and, if properly constructed and fixed, will not get out of order. If, in addition to the usual drain communications, pipes are laid from the open air into the sewer, at points midway or nearly so between the fans, it is evident that the air currents, established along the sewer by the rotation of the fans, will remove the gases as they



emanate from the sewage. Thus the power of the water flowing in the sewers not only carries off the sewage, but, by falling into the fans, with air pipes to and from the sewers in connection with the atmosphere, it is made available for ventilating the sewers as well.

Some New Phosphoric Compounds.

A. Gautier has prepared a singular compound of phosphorus with oxygen and hydrogen, which has the formula P_4HO. If a certain quantity of crystallizable phosphorous acid is sealed up in a tube with 5 or 6 times its weight of terchloride of phosphorus and heated to 79° C., hydrochloric acid and pyrophosphoric acid are produced. A bright yellow colored compound gradually separates, and can be obtained by first distilling off the excess of chloride of phosphorus, cooling the residue to—10° C., adding ice water, and then filtering. After washing on a filter, it is dried in a vacuum and then heated to 140° in a current of carbonic acid gas. The reaction is thus represented: $11PCl_3 + 27PH_3O_3 = 4P_4HO + 11P_2H_4O_7 + 33HCl$. When the reaction takes place at a temperature of 170° C., red phosphorus and pyrophosphoric acid are formed. The compound P_4HO is an amorphous body possessing a beautiful yellow color, insoluble in water, alcohol, ether, benzol, chloroform, oil of turpentine, glycerin, and acetic acid. It can be heated to 250° C. in dry carbonic acid without change. Heated in the air, it burns slowly with flame; mixed with chlorate of potash, it is exploded by percussion.

The same chemist has also obtained a compound whose formula is P_5H_3O, by mixing the biniodide of phosphorus, PI_2, rapidly with a large quantity of water. The new body is amorphous, of a pure yellow color, tasteless and odorless, and insoluble in any solvent. It is oxidized very violently by ordinary nitric acid, also by sulphuric acid. Heated in a current of dry carbonic acid to 135° C., it is decomposed, phosphuretted hydrogen being evolved. Ammonia forms with it a brown compound; but on neutralizing with hydrochloric acid, the original substance is restored. The properties of the body P_5H_3O seem to agree with those of solid phosphuretted hydrogen, P_2H, described by Thénard.

The Industrial Expositions.

The reports of the openings of the various industrial fairs throughout the country indicate the strong favor with which this graphic system of demonstrating the material progress of the nation is regarded by the people From all accounts, the number and variety of the productions displayed has never been exceeded during any previous year; nor does it appear that any single fair has, from the hour of its commencement, failed to attract throngs of interested visitors.

The Chicago Inter-State Exposition, a full description of the immense buildings of which (800 feet long by 200 feet in width), constructed through the generosity and enterprise of the citizens of Chicago, we have already presented, was recently formally opened, and during the first day of the exhibition 20,000 people entered its doors. Regarding the articles displayed, it is yet early to particularize. We learn that every department is complete in a full representation of the important arts and industries to which each relates, so that in our future references to this fair will doubtless be found descriptions of many novel and important inventions.

To the Kansas City and Cincinnati expositions, we have already alluded in detail. Both are succeeding admirably, and exciting no small interest in their respective vicinities. Indiana, in her State Fair now in progress at the Fair Grounds of her capital city, is making an excellent show of the manufactures and industries carried on within her borders. Louisville, Ky., celebrates a second Annual Exposition, and in St. Paul, the Minnesota State Fair was recently opened. In Baltimore, the 26th Annual Exhibition of the Maryland Institute, and in New Orleans, the Louisiana Fair, will afford the manufacturers of the Southern States a means of displaying local productions. Canadian industries will find representation in the Montreal Exposition and in the International Fair soon to be opened in Buffalo, N. Y. The excellent results of the experimental show of 1872, in Newark, N. J., has stimulated its projectors to new efforts, and we are promised an exhibition even superior to the very creditable one of last year. In Albany, we learn that the New York State Fair is attracting 20,000 people per day, and that the display of live stock, especially, has never before been equaled. In our own immediate neighborhood is the Kings County Fair, held in the Rink on Clermont avenue, in Brooklyn, and devoted to the local manufactures and industries of our sister city; while in New York is in successful progress the 42nd Exposition of that patriarch among fairs, the American Institute.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]
From September 6 to September 9, 1873, inclusive.

BLAST FURNACE.—T. F. Miner, Albany, N.Y.
ENGINE VALVE.—H. I. Hoyt, Norwalk, Conn.
FLOCK CUTTING MACHINE.—J. Pitts, Melville. Mass., *et al.*

Recent American and Foreign Patents.

Improved Pruning Knife.

Abraham C. Hulse and Joseph S. Crum, Palmyra, Ill.—This invention consists in constructing the parts of a pruning knife in such a manner that it may be quickly and conveniently changed from a shrub to a tree pruner or the reverse.

Improved Chain Clamp.

Charles E. Evard, Leesburgh, Va.—This consists in movable jaws, provided with rectangular recesses across the upper corners and horizontal chain rest, the said jaws when closed leaving an intervening open space large enough for the downward passage of the rivet.

Improved Ventilator.

John Ballou, Boston, Mass.—This is a frame in which a revolving ventilator is arranged so that the draft can be governed and light not be excluded. The device consists of four wings, two of glass and two of wire gauze, amounting to two planes set at right angles to each other. By a quarter revolution, the glass will be thrown into a horizontal position, and the perforated pieces will take its place, thus admitting air while excluding insects.

Improved Farm Gate.

Edward B. Decker, Carrollton, Ill.—This invention is an improvement in in the class of farm gates wherein the lower part may be raised and lowered independently of the upper part. Two lower bars are pivoted at their rear ends to one of the gate standards or cross bars. Their forward ends enter slots in the opposite cross bar. To one of the upper horizontal bars is attached a latch and hook, the latter of which, when the lower bars are raised, catches their forward ends and holds them up.

Improved Milk and Cream Cooler.

Henry C. Baldwin, North Wolcott, Vt.—The outer vessel of this cooler is provided with a spout upon its upper part for pouring in, and with a short pipe in its lower part for drawing off, the water. There is also an opening to allow the waste water to escape when a stream of running water is introduced into the spout. A ring flange is attached to the bottom of the outer vessel to support the inner vessel, so that there may be a water space between the bottoms, and has a number of holes to allow free circulation. To the outer vessel are pivoted hooks to keep the inner vessel in place when the water is poured in. The cover has ventilators to allow the air to circulate freely, the mouths of said ventilators being covered with wire gauze.

Improved Fluting Machine.

Edward M. Deey, New York city.—The first part of the invention consists of an arrangement of devices for adjusting the roller and regulating the pressure, whereby the roller which is raised to facilitate the adjusting of the goods can be raised without contracting the pressure springs. Less power is thus needed than is required to lift it against the springs. The second part consists of guides in connection with the roller to control it against lateral vibration. The third part consists in having the wheel by which motion is imparted to one of the rollers provided with and rigidly attached to a short shaft which couples with the roller, so that the latter can be removed without disturbing the wheel, and without the necessity of sliding the wheel off and on a portion of the roller.

Improved Steam Lubricator.

Reed A. Filkins, Cheshire, Mass.—It is proposed to have a hollow globe holder for the oil, having a hollow standard, with a conical enlargement of the hollow space at the lower end. This end screws into a hollow stand on the steam chest or journal box. A stationary conical plug projects upward from the bottom of the socket into the hollow of the lower end of the standard, so as to regulate the flow of oil by closing the mouth of said standard more or less, as the holder and standard are screwed up or down. The holder has a notched ring around its middle, which is graduated and numbered to show the extent of the opening of the feed at the mouth of the standard, and a spring click engages it to hold the oil holder to any position in which it is set. From the socket below the standard of the holder the oil enters a little chamber, in the middle of which a tube rises around the passage from said chamber into the steam chest to retain a quantity of oil in said chamber. In feeding, the oil will flow from the surface of the body contained in said recess, on the top of the tube, and down the inner surface of it, while the steam rises up in the center of the space. There is a valve which will screw into the proper passage and close it, so that the steam may be shut off at any time to allow of taking off the holder when it may be desired to do so.

Improved Breech Loading Fire Arm.

Daniel Hug, New York city, assignor to himself and William H. Speer, Jersey City, N. J.—This invention consists in a pivoted breech block, having a spring hook connected therewith and a cartridge extractor arranged centrally beneath the barrel, combined, to extract the old cartridges and throw them clear of the gun, as well as support the new one.

Improved Projectile.

James G. Hope, Wichita, Kas.—This invention is more particularly an improvement on the projectile for which letters patent were issued to applicant October 4, 1870; and consists in providing the stem of the projectile with a double set of guide wings, one for preventing its rotation during flight, and the other for causing it to describe a curve of greater or less radius.

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Improved Can Soldering Machine.

James F. Spence, Williamsburgh, N.Y.—This invention consists in providing means for feeding cans to a soldering apparatus, and for reversing them so that both heads may be soldered to the body in rapid succession and without the removal of the same from their holder.

Improved Ventilating Window Sash.

Collin Pullinger, Philadelphia, Pa.—This invention relates to convenient modes of ventilating rooms through the windows without bringing to bear upon the persons therein a cold draft of air. The invention consists in a novel arrangement of a small supplementary sash to slide above the top and to the bottom sash.

Improved Rudder for Vessels.

Juan B. Baptista, New York city.—This invention is an improvement in rudders of the hollow class, and consists in forming a balanced rudder of two parallel plates attached to transverse bars, which impart rigidity to said plates, and are in turn secured to the vertical shaft in such a manner as to leave a space between each of said plates and the shaft. The object is to increase the surface acted on by the water.

Improved Fence.

Wilbur S. King, Gonzales county, Texas.—This invention relates to fences adapted to those parts of the country where stock farming is pursued, where timber is scarce, and where the object is to make a fence which will turn hogs as well as cattle and horses, at the same time being cheap, easily put up, and susceptible of quick and ready repair. It consists in posts, rails and stakes, wired together so as to allow the lower parts to be filled with brush.

Furnace for Producing Wrought Iron from Ore.

George E. Harding, New York city.—This invention consists in combining, with a rotary puddling furnace, a gas-producing furnace and a deoxydizing chamber, so that the waste gases may be conveniently applied to deoxydize and carbonize the ore preliminary to its reduction.

Improved Combined Wardrobe, Bedstead, Chair and Table.

Walker Getchell, Bath, Me.—The front of the cabinet has narrow sides, constituting the pendent sides of the table top when detached from the case and arranged for the table. The folding legs are pivoted to it, being let down and fastened by buttons. Part of the top of the cabinet constitutes the back of the chair, and has the seat hinged to it. It also has an upholstered cushion above the seat; and this is so fitted on the back and connected to the seat that, when it swings down against the side of the back to adjust the latter for its place in the cover, it draws the cushion down below the top to uncover the end sufficiently to rest on the top of the sideboard of the cabinet, and when the seat swings up into position it moves the cushion up to hide the back. The sides of the chair are formed of two boards, which nest together so as to be laid on the top of the cabinet and constitute the balance of the cover. The sections of the sides of the case, and boards between the front and the main part, comprise the principal portion of the bed or reclining couch. The wash stand, with a towel rack attached, is mounted on a door, which is hinged to the side where an opening is made in the side of the case into a chamber within, so that the stand swings into the case and is inclosed when the door is shut, and swings out for use when the door is opened. At the side opposite the one having the wash stand, a drawer is arranged for linen and other like goods.

Improved Umbrella.

John McAuliffe, New York city.—The inventor makes clips or laps for fastening to umbrella ribs, to pivot the braces to, by taking little strips of sheet metal, well coated with tin, and folding the ends over back on one side, enough to make the elevation of the folded part about half the thickness of the rib, and so that the space between the said folded part will be just enough to wrap around the brace and inclose it snugly when the folded parts meet on the inside of the rib. A projection is thus formed to which the branched end of the brace can be pivoted. These ends and the folds are united together, and also the lap to the rib, by a drop of solder.

Improved Wheel Plow.

Lionel W. Richardson, Roscoe, Ill.—This invention is a sulky attachment, which may be applied to the beam of an ordinary plow. The axle is bent in peculiar shape. One wheel works on a crank axle, which, by a suitable lever, may be adjusted so that the wheel may run in a furrow or on the surface and the machine still remain horizontal. The plow has a free lateral and vertical movement, easily governed by a lever at the hand of the driver.

Improved Machine for Turning Wagon Axles.

George A. Bolser, Indianapolis, Ind.—This invention consists of a nove arrangement of the tool carrier, pattern, and feed screw, in a machine in which the stick to be turned is stationary and the cutter is revolved around and fed along the stick. The axle, the ends of which are to be turned, is laid on a bench between the posts and centered by suitable means. A large short tube is bolted to the posts in the axis of the machine, so that the axle to be turned projects through it. A pulley revolves on this tube, and carries the face plate, in front of which, at a suitable distance, is another face plate, in four arms, arranged on the sleeve of the tail center and connected to the first face plate by a rod, feed screw, tool supporting rod, and the pattern rod or centers, all of which are arranged at equal distances apart around the axis, and at equal distances therefrom. The pattern is a facsimile of what is to be produced. It extends from the face plate to one of the arms, and is fixed on them so that it can revolve, making one revolution on its axis during each revolution which it makes around the axle. The tool holder consists of a freely moving bar, and it rests on the pattern. The cutter is attached to the bar on the side next to the pattern. The tool bar is moved along slowly in the direction of the axis of the axle to carry the tool from one end to the other of the part to be turned. It is also proposed to utilize this machine for making oval tenons on spokes upon the same plan.

Improved Wood Filling.

Jerome B. Dittenhaver, Chapaleau, Ohio.—This invention relates to a compound for filling wood previous to the application of a paint or varnish, and consists in a preparation which is entirely devoid of color, and will not therefore change the characteristic hue of the wood, which can be applied with an equally favorable result to all varieties, and which permeates so thoroughly the pores and fills so completely the interstices between the fibers that a single coat of varnish or paint will be generally sufficient to produce the designed outside face upon the wood.

Improved Railroad Water Crane.

Henry S. Cubberley and David Mann, Bloomington, Ill.—This invention consists in a frost proof jet, above which is a hollow standard surmounted by a movable bent tube. Within the standard is the valve rod, to the lower part of which is attached the valve. The rod continues on down below the latter and is encircled by a spring which forces the valve up against its seat. On the upper part of the valve rod is a rack, in which works a pinion, connecting by suitable mechanism with a hand wheel outside. By this means the valve is opened or shut.

Improved Harness Maker's Clamp.

Daniel Eighme, Chicago, Ill.—This invention relates to apparatus for holding leather in the operation of sewing it for harness or shoe making or other purposes. The stand is wedge-shaped, and on each of the inclined sides of the wedge there is a rib. There is also a shoulder on each side equal to the thickness of the lower end of the jaws. The inner sides of the jaws are grooved for the ribs and fitted to the inclined sides of the wedge. The jaws are raised by pressing on a lever, and when raised are lowered and are spread apart by a spring. Vertical springs draw the jaws down and hold them in their normal position, which is to tightly clamp the leather. The jaws act as levers, and turn slightly on their fulcrum rods when raised or lowered.

Improved Spring Hinge.

William Hoar, Floyd, Iowa.—This improvement consists in attaching a standard to one leaf of a hinge, and connecting a spring encircled extension thereof with the pintle of the hinge. On opening, the spring is compressed so that the action of the same on the door produces the shutting of the latter, securing also at the same time sufficient resistance against the accidental blowing open by the wind or otherwise.

Improved Portfolio Holder.

Jonas B. Aiken, Franklin, N. H.—This invention relates to portfolio holders which are adapted to be fastened conveniently against the wall of a room and above the wash board. It consists in the mode of combining the two side frames with the bottom support of the portfolio, so that the latter may be held closely locked and protected against unnecessary handling while it may be also held at an oblique angle so as to be easily examined. It also consists in providing the portfolio supports with end guards which prevent withdrawal of the portfolio and are adjustable to those of different sizes.

Stop Mechanism for Doubling and Twisting Machines.

William Cockcroft and Reuben Ackroyd, of Chester, Pa., assignors to themselves and James Massey, of same place.—This invention consists of a stop motion in connection with the feeding or delivering roll of a twisting machine, so contrived that if the threads or yarns break it will stop the delivery, and thus prevent the ends from going from one spindle to another. The tension of the yarn holds the inner weighted end of a lever up above stud pins on the pulley of the delivery roll so long as the yarn remains taut and unbroken, but when the yarn breaks the inner end of the lever will fall and stop the delivery roll by engaging one of the stop pins, and thus prevent the further delivery of the yarn until it is mended.

Improved Machine for Rolling Round Tapered Bars.

Charles F. Brown, Warren, R. I.—The object in the present invention is to facilitate the manufacture of spindles and all articles of tapering form and it consists of two eccentric disks revolving in opposite directions on a central arbor in a suitably constructed frame, so beveled as to roll or straighten a tapering spindle or other article, and in one or more guides through which the article to be tapered is introduced. The eccentric surfaces have the effect of inclined planes upon the spindle, approaching each other in one part of their revolution, and receding from each other in another part, while the spindle simply revolves and receives its form and shape from the pressure imparted by the beveled and eccentric revolving surfaces.

Improved Saw Tooth Gage.

Cyrus E. Grandy, Stafford Springs, Conn.—This invention relates to an ingenious apparatus for temporary attachment to the saw mandrel of a circular saw, to gage the teeth round and as to the set; and consists, first, of improved means for attaching the sweep to the mandrel; second, a templet in combination with the sweep, to insure the parallelism of the sweep with the saw, and an arrangement of the tooth gage supporting arm in the end of the sweep to shift laterally, as required, to adjust the gages to the plane of the saw; third, an arrangement of the gage holding arm to oscillate in the sweep, to adjust the gage to the front face of the teeth; fourth, an adjustable gage, with a scale so arranged on the aforesaid arm that the angle of the teeth front may be gaged by it with certainty (it is also arranged so as to gage the teeth round); fifth, an adjustable gage on the aforesaid arm for gaging the set of the teeth; and, sixth, an upsetting swage holder on the said arm.

Improved Compound Metal Working Machine.

George L. Jones, Vanville, Wis.—The object of this invention is to furnish for the use of blacksmiths and wagon manufacturers a combination tool, by which the operations of cutting and punching iron, and the tightening, upsetting, and bending of tyres may be accomplished in a single machine. The frame of the instrument, of oblong shape, is firmly secured to the ground, and provided with strong vertical standards between which is pivoted an eccentric which is operated by a lever. The eccentric operates on the knee joint levers, one of which is hinged at its outer end to a heavy block, moving in a recess of the frame. The block is pivoted with its lower end to frame, and provided with a cutting blade which acts on a similar blade of the frame in the manner of shears. The other knee joint lever is hinged to a sliding carriage which moves in a recess, and to which is secured, in the direction of the longitudinal axis of frame, the puncher, which acts on a perforated steel cutter in a socket. The upper side of carriage is grooved and has a vertical extension plate which carries a strong bar or bolt and a partially grooved eccentric. Other eccentrics and grooved bases are arranged, between which and their corresponding grooved bases, the wagon tyre is clamped and either tightened or upset when off the wheel, as required, by the lever acting on carriage. For bending or rolling the tyre the cylindrical rollers are arranged sidewise of the frame. The outer rollers are adjustable for tyres of different sizes and thicknesses. The notched roller is placed between and above the outer rollers and turned by a crank, giving the bend to the tyre on its passage through them.

Value of Patents,

AND HOW TO OBTAIN THEM.

Practical Hints to Inventors.

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Larger inventions are found to pay correspondingly well. The names of Blanchard, Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe, and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

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HOW TO OBTAIN *Patents.* This is the closing inquiry in nearly every letter, describing some invention which comes to this office. A *positive* answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model Drawings, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men, the inventor may safely confide his ideas to them they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his rights.

How Can I Best Secure My Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows, and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row, New York, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office. Such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these with the fee of $5, by mail, addressed to MUNN & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

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Rejected cases, or defective papers, remodeled for parties who have made applications for themselves, or through other agents. Terms moderate Address MUNN & Co., stating particulars.

To Make an Application for a Patent.

The applicant for a patent should furnish a model of his invention if susceptible of one, although sometimes it may be dispensed with; or if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft, or postal order, on New York, payable to the order of MUNN & Co. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

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A reissue is granted to the original patentee, his heirs, or the assignees of the entire interest, when, by reason of an insufficient or defective specification, the original patent is invalid, provided the error has arisen from inadvertence, accident, or mistake, without any fraudulent or deceptive intention.

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Did patentees realize the fact that their inventions are likely to be more productive of profit during the seven years of extension than the first full term for which their patents were granted, we think more would avail themselves of the extension privilege. Patents granted prior to 1861 may be extended for seven years, for the benefit of the inventor, or of his heirs in case of the decease of the former, by due application to the Patent Office, ninety days before the termination of the patent. The extended time inures to the benefit of the inventor, the assignees under the first term having no rights under the extension, except by special agreement. The Government fee for an extension is $100, and it is necessary that good professional service be obtained to conduct the business before the Patent Office. Full information as to extensions may be had by addressing MUNN & Co., 37 Park Row.

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Boring Machine for Pulleys—no limit to capacity. T. R. Bailey & Vail, Lockport, N. Y.

Notes & Queries

C. A. P. asks: How can I braze a broken cast iron vise?

H. asks: How can I make the best bleaching liquid for washing clothes?

J. W. R. asks: What is a good artificial bait for sunfish? "Grubs are scarce in my locality."

T. W. B. asks: As Professor Wise doubtless ascertained the tensile strength of the material composing his balloon, as well as the pressure to be borne by it (determined by the required weight to be raised), what was the amount of the explosive force?

W. H. B. asks: Is there a substance or combination of substances which is combustible, and easily ignited with a match, either with or without the use of a wick? It must produce as intense a heat as possible, be easily melted, and if poured in that state upon a flat piece of ordinary solder must adhere so firmly as, when hardened, not to become removed by ordinary handling or by transportation, and be reasonably cheap.

Answers to Correspondents

W. P. H.'s query is incomprehensible.—J. J. H.'s question is a professional one; he should consult some good engineer.—J. S. B. should read the description of lead pencil making on p. 84, vol. 27.

F. O. B. asks: Would it not be a good idea to place air pumps on a locomotive engine, so that, in descending a grade, instead of putting on the brakes of a train to arrest the motion, that the air pumps could be used to force air into the boiler, thereby increasing the pressure in the boiler and utilizing the power which is usually wasted in applying the brakes? And could not the steam cylinders themselves be used for that purpose? Answer: Both plans are old.

B. A. K. asks: Will a broad gage locomotive run 200 miles in a shorter time than one built on the narrow gage plan, each being built alike and proportioned to the gage, the broad gage, of course, being much the larger? 2. Does a broad gage locomotive carry more dead weight in proportion to its size than the narrow gage? Answers: 1 and 2. We can see that there might be differences between the performances of the two engines, but one would not necessarily have any advantages over the other.

F. O. C. asks: 1. Who was the first inventor and builder of the locomotive engine, and who laid down the first railroad? 2. Would a leaden tank do for storing muriatic acid in large quantities? 3. What metal is used in place of nickel in plating? Answers: 1. Cugnot, a Frenchman, built the first locomotive, in 1769. The Stockton and Darlington Railroad, in England, was built in 1825. This was the first. 2. It probably would. 3. Read the article on page 307 of our volume XXVII.

E. L. asks: What is the highest degree at which water can be boiled? If I have 15 lbs. of steam in a boiler and build a large fire in order to get it up to 80 lbs., is the water any hotter at 30 lbs. than at 15 lbs.? Answer: The boiling point of water depends upon the pressure to which it is subjected. See article on "Properties of Saturated Steam," on page 81 of our current volume.

G. asks: How can I calculate the horse power of engine? From what book can I learn all about engines and pumps? Answer: We cannot answer the question about horse power without more data. You will find rules given in former answers to correspondents. Probably the best book for you to commence with will be Bourne's "Catechism of the Steam Engine," which can be obtained from D. Van Nostrand. There are many things relating to engines and pumps that cannot be learned from books, and can only be discovered by observation.

C. G. H. asks: When out of sight of land, how will Professors Wise and Donaldson know in what course they are moving? The compass will point out the north; but as the balloon has no stem or stern, they can not tell which way they are going. Answer: Mr. Donaldson informed us that he proposed to obtain the course by dropping something from the balloon, and observing the direction with reference to that.

W. B. asks: If a horizontal pipe, of 6 inches inside diameter, about a foot long, having connected on one side a half or three quarter inch (inside diameter) pipe, standing erect, about 4 feet long: and at the other side simply a prop or bolt, which slides out in proportion to the water pressure from above, and pushes against an object in its immediate front: will there be a horizontal forward pressure, and none backward? 2. If so, how much, by a pipe 4 feet long and half an inch bore, standing erect, with a 6 inch bore of a foot long horizontal pipe? 3. If the water is forcibly driven in, will the force, resulting in the forward pressure, be equal to the force above expended, or greater? Answers: 1. There will be both a forward and backward pressure. The latter pressure can be resisted by a plug in the pipe. 2. The amount of this pressure will be about 49 pounds. 3. If the water is pressed above, the forward pressure will be increased.

W. C. B. asks: 1. What is the limit of the hight to which a siphon will draw water, or what is the highest point at which it can be worked? Will it do any good to let the pump down in the ground 10 feet, and let the pipe run over the top of the hill on the surface of the ground? Answer: From 30 to 32 feet is the greatest hight in practice, and any lift above 28 feet causes great difficulty. If the pump is lowered, the whole pipe must be lowered as well, to get the benefit of the decreased lift.

E. G. F. asks: Is there a book devoted exclusively to stationery and portable engines, their construction, management, etc.? Answer: Yes. See catalogues of some of the leading publishers who advertise in this paper.

A. L. K. says: Is it possible to produce an artificial frost over an area of some square miles? Answer: Not in the present state of science.

S. J. O. asks: Where can I obtain the "Table of Change Wheels for the Screw Cutting Lathe," recently reviewed in your columns? Answer: We are unable to add any information to that already published in our notice of the work.

M. O'R. asks: 1. Where can I find a description of Professor Boyle's experiment or device for correcting the form of lenses, to which experiment or device allusion is made on page 43, current volume. 2. Is there any method or process for depositing nickel on glass, similar or analogous to the process by which silver is deposited on glass? I want to get a bright metallic coat of pure nickel on glass, which may be polished for reflecting purposes. Can it be done, and how? Answer: 1. Professor Boyle arranged a pair of six inch achromatics as a binocular telescope. The novelty of his machine for local retouches consisted in the employment of a lozenge-shaped local polisher instead of the usual round one. Robert Browning of London makes silvered glass mirrors, and sends a pamphlet for a shilling. Mr. Clark tried one of his 13 inch specula and found that the diffraction around the three strips of steel supporting the diagonal mirror caused the image of a star to appear with six wings. 2. Professor Draper has completed with his own hands a silvered glass mirror, twenty-eight inches in diameter. It is supported on an india rubber air cushion. Professor Smith recommends nickel-plating cast iron specula, but these require careful annealing. The silver coating tarnishes wherever the air contains compounds of sulphur. In towns, therefore, the silver coating of glass mirrors should be nickel-plated by the battery after polishing.

J. F. S. asks: Would the collection and condensation of the gas or gases arising from hot muriatic acid, after it has done its work in clearing tin scrap, be patentable? Answer: Whether your method is new depends upon how you collect and condense the gas. If you condense by means of an ordinary condenser or worm, or receive the gas into cold water, there is nothing new in it. But this plan of collecting and saving the hydrochloric acid gas might be combined with your process of cleaning tin scraps and be patentable, as might also improved machinery for effecting either result. Improvements for preventing the escape of gas into a room would also be patentable.

C. E. F. asks for directions for preparing cupro-ammonium. Answer: Ammonio-cupric oxide or cupro-ammonium consists of a solution of cupric oxide or black oxide of copper in aqua ammonia. It may be produced by precipitating a solution of a copper salt, as the sulphate, by strong ammonia, and then adding ammonia in excess so as to dissolve the precipitated oxide. In this case, however, it is not pure, as the acid of the copper salt, when the oxide of copper is precipitated, combines with the ammonia, forming an ammonia salt, which remains in solution. To form pure ammonio-cupric oxide, dissolve pure black oxide of copper in the strongest aqua ammonia.

W. R. asks: Is there any kind of air pump that will produce a stronger pressure of air against any object than a good strong wind? If so, how much would such an air pump weigh, and how heavy an engine would it take to run it? Could they both be taken up in a balloon? Would it be practicable thus to drive a balloon against the wind? Answer: Such air pumps are made, but the machinery would be too heavy to be practicable for use in a balloon.

W. B. asks: Why do music boxes squeak after they have been cleaned? The noise is not in the running machinery, but in the steel reeds which the pegs of the roller strike on. Answer: Probably the noise is due to friction between some of the reeds and pegs.

A. asks: Why cannot we do away with sails on lake boats, and run them with windmills, so constructed as to work a screw? Answer: The idea is old and impracticable. By no manner of device can you make the wind drive a boat directly against the wind. You can sail obliquely, and for this purpose the ordinary sails would give you more propelling power, in a more convenient form, than any windmill.

G. V. H. says: My house is stone, with walls 18 inches thick. The roof is tin, with ordinary pine sheathing, and I shall ceil it with pine. What material would be best to put in between the roof and the ceiling to keep the upper story cool in summer and warm in winter? Would sawdust answer the purpose? Answer: Sawdust filling in this case is objectionable: first, on account of its tendency to induce decay of the timber, either rot or dry rot; second, because it will decay itself and find its way through the joints of the boarding, thus filling the rooms with dust and deteriorating the air. The usual course in such cases is to suspend strips at from one to three feet below the roof joists and at about two feet apart, and to put the ceiling upon these, thus depending upon a large air space between the ceiling and the roof, as a non-conductor of heat. The strips are made firm by being braced at short intervals to the joists; and if a plastered ceiling is required, a series of narrow cross strips are nailed to the other sat 12 inches apart, to which the lath are secured.

R. B. C. says: In regard to D. B. M.'s answer to inquiries respecting a noon mark, I wish to ask: 1. Why do the observations have to be taken 12 hours apart? 2. How am I to tell when it is noon? Is it when the shadows of the two plumb lines coincide? 3. What kind of an almanac will tell how much the sun is fast or slow? 4. Can you give a rule for calculating the true meridian from the results obtained by the plumb line arrangement? 5. Is there any more reliable apparatus for determining the meridian than by using plumb lines? Answers: 1. No. In 11 hours and 58 minutes, the north star completes half a revolution about the pole. The pole star is on the meridian about seventeen minutes after the plumb line covers both it and Alioth, (*epsilon Ursæ Majoris*) fifth star of the Dipper, beginning with the pointers. The plumb lines may also be ranged with the north star at its greatest eastern or western elongation. Then, if the lines are 100 inches apart, one of them must be moved two and six tenths inches to range with the pole. 2. Look at the almanac for "sun at noon mark," which is the required correction. 3. A "newspaper almanac." 4. The plumb lines are placed in the true meridian, that is, they range due north and south. 5. Yes; by using the solar compass, transit, etc.

G. R. asks: Is there any difference made, in the amount of water discharged by an hydraulic ram, by increasing the size of discharge pipe from one inch to one foot in diameter? The fall to the ram is 10 feet; hight to raise, 60 feet. Of course the size of pipe (1 inch) is already sufficient to allow a discharge of fifty times more water than is elevated by the ram. Does the size of the pipe, by exposing more or less surface to water, offer more or less friction, and thereby vary the amount discharged? Answer: Unless the supply pipe is very long, a diameter of one inch will probably give better results than a diameter of one foot. This is on the supposition that the ram is properly designed for a pipe one inch in diameter.

W. G. A. asks: Would not one bumper on a railroad car do as well as two bumpers? Answer: No. One might but not as well as two.

J. W. H. asks: 1. How can I determine when water is foaming in a steam boiler? 2. What is generally used for cementing grist mill stones, and for fastening smaller sized stones in iron cups? 3. I have a 30 inch corn mill. The top stone is broken in two in the center, and the cement, from exposure to the weather, has rotted. I made a thin solution of plaster of Paris, set the burr or stone, and then poured the solution around the burr in the cup. It is a failure and does not become hard. What shall I do? 3. Can you give me instructions how to temper mill picks? Answers: 1. Violent foaming is sometimes shown in the glass gage. It is generally indicated by trying the gage cocks, and observing whether solid water or a mixture of steam and water issues therefrom. 2. Set the stone in the cup, filling up the back with a cement composed of plaster of Paris. Fill the interstices between the stones with a cement composed of powdered alum and a powder made from small pieces of the millstone. 3. Picks are frequently tempered in brine.

D. B. says: Suppose I have a steam cylinder, with 50 inches area, and 20 lbs. constant pressure, and insert two pistons, admitting steam in center between the pistons, so that they are both forced outwards, would each piston overcome a resistance of 1,000 lbs. (less friction), or the two only 1,000 lbs. collectively? Answer: Each would exert a pressure of 1,000 pounds.

C. M. N. asks how to precipitate sal ammoniac and nitrate of silver. Answer: The latter can be precipitated by hydrochloric acid or any chloride. If in a solution by itself, it will crystallize out on concentrating the solution by evaporation. The two salts cannot exist in the same solution, as the sal ammoniac would precipitate the silver. Sal ammoniac is precipitated by the bichloride of platinum in concentrated solutions. If C. M. N. will give a more precise explanation of what he wants, we may be able to assist him.

W. M. F. asks: 1. What is the use of a storm glass? 2. How is it used? 3. Should the long and narrow bottle be full, or does it make no difference? 4. How can I tell the approach of a storm by the use of the storm glass and thermometer combined? 5. How can I make muriate of ammonia? 6. How can I make malic acid? Answers: 1, 2, 3, 4. It is not necessary that the phial should be full. When the liquid is clear it is a sign of fair weather. If the solid particles rise in the liquid, it signifies rain. Before a storm or very high wind, the liquid will become thick. 5. From the ammoniacal liquors formed in the manufacture of coal gas. 6. It is generally obtained from the berries of the mountain ash. You would do well to consult some standard work on practical chemistry, as we have not space to give details of manufacture in these columns.

G. B. D. asks: 1. What is the most economical speed in feet per minute to run a rotary steam engine, which is constructed on the old plan of hollow shaft and arms, through which the steam passes, exhausting at the curved ends of said arms, always in an opposite direction? 2. What per centage of economy can be realized from the above plan, compared with the best form of reciprocating engine? 3. Would there be any gain of power if the steam, in exhausting from the curved arms, came directly in contact with the inner ratcheted face of another wheel, causing it to revolve in the opposite direction, the two emitting their power by means of one cross and one straight belt, leading to another shaft at suitable distance? 4. What is your opinion in regard to a series of feet being connected to each other by means of links or hinges, their inner faces being provided with rollers, the whole forming an endless traction device, revolving around an endless track and propelled by engines mounted on the frame? Some twenty patents have been allowed to different inventors for certain improvements on this form of traction engine during the last 12 years, and yet there seem to be none in use, either because the whole machine combined is too complicated, or the connections, being constantly exposed to grit and dirt, are not durable. Suppose these revolving feet to be 4 feet x 14 inches each, and they are so connected that one does not leave the ground until the next one relieves it; if we construct a traction engine with two traction wheels 6 feet diameter by 2 feet face, both being secured to one shaft which is driven by engines of the same power as the ones employed to drive the endless traction machine, which of these plans will draw the greatest load at the same speed, and which would be the most practicable for every day use? 5. What is the object in the rubber tire used on road steamers? Is it to give increased traction or is it for the purpose of relieving the body of the machine of the shock or concussion which would occur if the wheels struck a stone or other obstacle? Answers: 1. Generally speaking, the most economical speed for an engine depends upon its mode of construction, system of counterbalancing employed, etc., and no rule can be given that will apply to every case. 2. We have no record of tests that will enable us to answer this question. 3. If applied on the principle of the compound engine, there might be a gain. 4. Traction engines are largely used in England, and their introduction into this country is now fairly accomplished. There are several forms of traction wheels in use which have more adhesion than the engines of the machines can overcome. 5. Mainly for the purpose of gaining adhesion.

N. A. P. says: Two forms of screw propeller are tried on the same vessel, each screw or wheel being of the same diameter, and the pressure of steam in each trial being 60 lbs. It is found that, with wheel A, 4,000 revolutions are required to propel the vessel 1 mile in 8 minutes: while with wheel B, 3,000 revolutions make the 1 mile in 8 minutes. Is there a difference of power actually expended? If so, what? Does the furnace consume more fuel with wheel A on the shaft? If so, how much more? Answer: If we understand your question rightly, wheel B has 25 per cent more efficiency than wheel A, and consequently 25 per cent less fuel is required with this wheel.

A. F. B. says: 1. Is the pressure of steam on every square inch of the flues the same as it is on the shell of the boiler, or has steam the same pressure towards the center as it has from the center of the boiler? 2. Is the law that action and reaction are equal and in opposite directions applicable to the first query? Answers: 1. Steam presses equally in every direction. 2. Yes.

J. G. D. T. asks: 1. Does gunpowder, when ignited within an enclosure (as in a gun barrel, for instance) create pressure by producing air? 2. If so, is there a gradual expansion of its atoms, so as to create a gradual force? Answers: 1. The solid grains of the powder are converted into gases, principally nitrogen and carbonic acid. 2. There is an expansion, commencing with a pressure of nothing and rapidly increasing.

A. M. B. asks: Is it an uncommon occurrence to launch steam vessels with their engines and boilers in? Was not the Dictator launched with her machinery complete? Answer: It is not usual. The Dictator and most of the monitors were launched with their engines and boilers in.

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C. E. H. asks: Is there any way of removing coal tar from the bottom of a sail boat, the boat having collected it by laying in a dock near the gas works? Scraping will not answer. Answer: After scraping off as much tar as practicable, try naphtha as a solvent for the remainder. Rub with a sponge or cloth soaked in the naphtha.

P. asks: What is the best cheap preparation for preserving pine shingle roofs, to be applied either before or after laying the shingles? Answer: The article advertised as slate paint may answer your purpose.

J. B. S. E. asks: Is amorphous phosphorus soluble in any of the ethers? If so, what is the process? If not, what is it soluble in? Will the addition of another substance, not deleterious, make it soluble? Answer: Red or amorphous phosphorus is insoluble in the ordinary solvents of common phosphorus. According to Möhler, red amorphous phosphorus may be rendered colorless and perfectly transparent by fusing it in a concentrated solution of bichromate of potash mixed with sulphuric acid. After this treatment it usually remains liquid after cooling, but solidifies instantly when touched by a solid body.

E. L. says: Suppose four canals, each one mile long and thirty feet wide, to be six feet deep at discharge end, with water below, level with the bottoms. At the entrance ends, the depths are 5, 6, 7 and 8 feet respectively, with full supply of water at these depths, and regular grades between inlet and outlet: How much will each canal discharge in 24 hours? Answer: You can find approximately the velocity of discharge in feet per second, and from this the quantity discharged per second, by the following formula: V = velocity in feet per second, f = total fall in feet, A = cross section of canal in feet, l = length of canal in feet, p = length of wet perimeter in feet. $V = \sqrt{(10{,}000 \times f \times A) \div (l \times p)}$; or the velocity of discharge in feet per second is equal to the square root of the product of 10,000 by the total fall in feet and the area of cross section, divided by the product of the length and wet perimeter.

J. D. W. asks: Does the term steam engine include a boiler, or can an engine be complete without a boiler? I do not refer to portable engines. Answer: A steam engine does not include a boiler unless it is so stated expressly.

P. D. W. asks: What is magilp composed of? Answer: Magilp is a mixture of pale linseed oil and mastic varnish, used by artists as a vehicle for their colors. The proportions vary according to the work. It is thinned with turpentine.

C. M. L. asks: What can I put over silver leaf to keep its color? Answer: Try a varnish composed of pale shellac 8 ozs., rectified spirit, 1 quart; dissolve.

J. W. H. asks: Is it true that, the warmer water is, the more gas it will absorb? I mean any gas that can be absorbed by water. Answer: The general law is that the colder the water, the greater the quantity of the gas taken up and retained by it. Hydrogen is an exception, about the same amount being absorbed at all temperatures of the water.

H. H. M. asks: What is the name of some book that treats of the manufacture of carbolic acid, or how is that article manufactured? Answer: Carbolic acid is made from coal tar. The tar is distilled until anthracene comes over. The resulting oil is rectified, collecting separately the oil which distils over between 302° and 392° Fahr. This oil is mixed with saturated potash ley and powdered hydrate of potash, by which it is converted into a white crystallized mass. This substance is dissolved in hot water; the oil which rises to the surface is removed, and the lower alkaline liquid is neutralized with muriatic acid. Impure carbolic acid now rises to the surface as an oil. This can be purified by washing with a little water, digesting over chloride of calcium to dry it, rectifying several times, and finally cooling to 14° Fahr., when pure crystals of carbolic acid separate, from which the remaining fluid portion is poured off. We know of no treatise on the subject.

H. C. L. asks: Will a register placed in a wall six feet from the floor heat a room as quickly and as cheaply as one placed fifteen inches or less from the floor, and why? Answer: Yes: for whether the register is placed near the ceiling or the floor, the warm air will ascend to the former at once, unless some obstruction intervenes. Where a lower hall way connects with an upper one by stairs, and the register is in the lower hall, the warm air will not ascend to the upper one, because of the obstruction of the ceiling and the attraction of aggregation which subsists between the particles of the warm air; but in an ordinary rectangular room such obstruction does not exist. The proper place for a register for warm air, however, is at or near the floor, for convenience in warming the feet, etc., in very cold weather. All rooms intended to be warmed by the ingress of warm air should have a ventilation flue, having a register at the bottom and at the top of the room, to insure a proper inflowing of the warm air, and this flue should be on the opposite side of the room from the warm air flue.

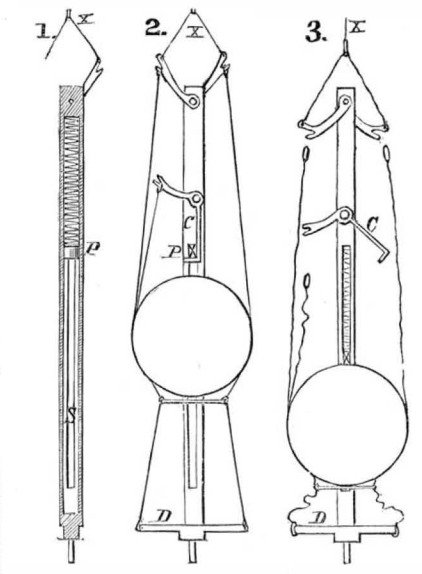
C. A. H. asks: By connecting a 2 inch hose to a 2½ inch, is there anything gained? Is it better than all 2 inch? Answer: The friction of the water will be decreased by this arrangement, and the pressure in the large hose will be the least.

K. asks: Is a mining lamp as safe if enclosed in finely perforated brass as in wire cloth? Answer: Yes.

E. C. G. asks: 1. Is there any way of replacing the gilt on a frame, and what is it? 2. How can I galvanize wrought iron? Answers: 1. You could scarcely do this work, if you have had no practical experience in the matter. We would advise you to entrust it to some one who makes a specialty of this kind of business. 2. Dip the iron into muriate of zinc, and afterwards into molten tin.

R. A. P. asks: What is the formula for ascertaining the proper hight and diameter of a marine engine smoke pipe, as used by successful engine builders? Answer: The practice of different builders varies greatly, and the best rule would probably be an empirical one based on data obtained from successful examples. For an approximate rule, the following is a very good one: Allow 200 cubic feet of air for the combustion of one pound of coal per minute; and having assumed a diameter for the chimney, and the number of pounds of coal to be burnt per hour, it will be easy to ascertain the amount of air required per hour, and the consequent velocity in feet per second. Then for a temperature of gas in the chimney, from 450° to 500° Fahrenheit, the hight of the chimney in feet necessary to produce this velocity is equal to one eighteenth of the square of the velocity in feet per second. More accurate methods are given in Professor Rankine's "Treatise on the Steam Engine and Other Prime Movers."

J. S. says, in reply to T. H., who asked if a spar of white pine could be used as a float for deep sea soundings: At the depth he mentions, namely, 5,000 fathoms, I am almost certain his spar, once down, would never rise again, for the following reasons: Dry wood is principally composed of cellulose, the specific gravity of which varies from 1·25 to 1·5; and were it not for the cellular structure of wood, it would not float at all, as is practically shown when it becomes water-logged. At a depth of 5,000 fathoms the pressure would be about 15,000 lbs. to the square inch, or 1,080 tuns to the square foot. I do not think white pine could resist such an enormous pressure. The use of a mixture to generate gas at the bottom of the sea is not impossible, but should say it is highly impracticable. Sea water is about 850 times heavier than atmospheric air; but at a depth of 5,000 fathoms, air would be compressed 1,000 times, and therefore would become heavier than water. Any gas of a greater density than air, such as carbonic acid, is of course out of the question. Hydrogen is the only gas that could be used. 1,000 cubic inches of hydrogen, at 60° Fahr. and barometer 30 inches, weigh 21·379 grains; at the above depth 1000 cubic inches would be compressed to 1 cubic inch. The weight of 1 cubic inch of sea water is 258·264 grains. Consequently 1,000 cubic inches of hydrogen would have a lifting power (at the above depth) of about 237 grains; or to lift 10 lbs., as T. H. wants to do, it would require 170 cubic feet of hydrogen. This scarcely requires comment. T. H. could easily accomplish his object by using as a float a flexible waterproof bag containing some liquid lighter than water, say a hydrocarbon oil of specific gravity 0·7. A cylindrical bag, 6 inches diameter and 2 feet long, thus filled, would have a lifting power in sea water of about 3 lbs, All liquids being nearly alike compressible, the difference of buoyancy between the bottom and the surface



would be very minute. As the deposit at the bottom of the sea is in some places, I believe, of a tenacious nature, T. H.'s sounding rod might possibly stick there, unless his float was inconveniently large. It might be advisable for him to provide for such a contingency by using the apparatus represented by the engraving. Fig. 1 is a tube with a slot, S, on either side, containing a loosely fitting piston, P, with two lugs projecting through the slots, also a strong spiral spring. Fig. 2 shows the spring held compressed by a catch, C. Fig. 3 shows weight and catch disengaged; the lugs of the piston, striking the weight, jerk the tube clear of everything. The disk, D, prevents the possibility of end of tube sinking in the bottom, without disengaging the weight. The float is attached at X.

A. T. A. says, in reply to G., who is troubled with red ants in his sugar: My sugar bucket contains about twenty-five pounds of sugar, and I am frequently troubled with these same red ants; but when so troubled I get three or four large black ants and put them in the bucket; and in less than three hours, not a red ant is to be seen, the black ones eating them up. As a means of preventing ants from getting on to a table, I put a piece of tobacco under each of the feet, and keep the table from contact with anything else.

R. S. H. says, in reply to C. F. B., who says that filing hand saws towards the point leaves more bevel on the front or cutting side of the tooth than on the back side: This is correct. He further says that the difference in the bevel is caused by the taper of the file. In this, I think, he is not correct. The difference of bevel on the two opposite sides of the tooth is caused by the position in which the file is held. If he runs his file level, while the saw is held plumb, he will find the bevel so nearly alike on the two sides that it will be difficult to decide which side has the most, showing that the taper of the file has little or nothing to do with it. Dropping the handle end of the file and elevating the point will and does produce the effect which he lays to the shape of the file. Moreover it produces a deeper cut, and a longer and more pointed tooth, which gives a sharper cutting point, and furnishes more space in which to carry the sawdust.

S. S. says, in reply to F. A. S., who asked for directions for constructing a stove to dry fruit, etc., without changing the color: He should have the dryer made of brick, or, if it is made of iron, have it fitted with a porous lining, and never allow the heat to get below 100° as the color changes in proportion to the time it takes to dry the fruit. If he intends to dry large quantities, it should be made with several chambers, that the green fruit may not be put in with that which is partially dry.

A. H. says, in reply to J. C. S., who asked about the dimensions of a belt per horse power: A 1 inch belt at a velocity of 750 feet per minute is a perfectly safe rule to calculate for one horse power. [There seems to be a considerable difference in the figures used for belting, and we shall be glad to hear from any of our readers who have made experiments. A rule by Mr. Rider, lately published, states that a belt one inch wide, and bearing on at least one third of the circumference of the smaller pulley, will transmit a force of 19·25 pounds, at any velocity. Applying this rule to the present case, we find that, with a velocity of 750 feet per minute, the belt would transmit $(19{\cdot}25 \times 750) \div 33{,}000 = 0{\cdot}431$ horse power.—EDS.]

T. M. G. says, in answer to a querist who asked if broken files can be mended: I have to say that my father once imported a lot of files, many of which arrived broken. He tinned them on the clean broken ends and "sweated" them together. In order to test the strength of the joint so made, one was struck across something, and the file broke within an inch of the joint.

D. R. says, in reply to a correspondent who asked how to harden jewellers' rollers: Put them in a cast iron box with carbon made from ivory chips, and keep the box at a dull red heat for 4 or 6 hours; then dip the rolls in water, or salt and water. They must be handled quickly from the box to the water, as the air spoils the surface.

A. S. G. replies to R. B.'s query as to passing trains as follows: Engine A can run on to the siding with eight cars, leaving the other eight on main track. Engine B then runs past, pushing the eight cars before it, after which A regains its place on the main track, getting out of the way while B puts the eight cars on to the siding, runs by them, and pulls them again on to the main track. The trains have now passed, and nothing remains but for A to pick up its cars, and go on its way. No problem of this kind is insoluble, as long as the siding can hold at least one car with its engine. [Answers similarly correct have been received from F. D. C., E. L. W., T. M. W., G. E. K., H. R. R., H. C. B., S. B. E., F. V. F., J. J. M., J. T., L. B. E. L., F. A. W., O. B. A. S., E. R. and J. N. P.—Eds.]

B. B. says, in reply to R. B.'s query as to trains passing each other: Two trains cannot pass each other under the circumstances described.

J. S. B. & Co. say, in answer to H. H. who asked for a cement for a leaky cast iron furnace: Clean borings or turnings of cast iron 1 lb., sal ammoniac, 2 ozs., flowers of sulphur, 1 oz. Mix them well together and keep dry. When required for use, take of the mixture 1 part, clean borings 20 parts: mix thoroughly and add a sufficient quantity of water. A little grindstone dust added improves the cement.

A. D. N. replies to A. P., who is troubled with water in his boiler: I guess you have no drain cocks to your cylinder or steam pipes, and that the water which troubles you is condensed steam collected in your engine while cooling off. Any engine is harder to start after cooling, partly because of the water of condensation and partly because the engine is cold. [A. P. says that when he uses a small quantity of water in his boiler, he does not have the trouble; hence it does not probably occur from condensation in the cylinders only.—EDS.]

D. B. says (in answer to A. B. F. who asks: 1. Does sulphur when burned for bleaching purposes do equally well whether the flame is blue or red with a sparkling blaze? 2. Does the burning in the two different ways produce same kind of gas? 3. What will prevent cotton or linen fabrics from becoming mildewed?) 1. The flame of sulphur is blue; the red blaze must be produced by some impurity. 2. The blue, of course, gives rise to the bleaching property. 3. Mildew can be prevented by the use of powdered sulphur.

G. W. W. says, in reply to E., who asked how to utilize several hundred horse power running to waste at a distance of 3 miles: Put a water wheel at the fall, and attach air pumps, lay a pipe from the pumps to the factory, of suitable size, then connect to your engine the same as with steam. Start your pumps and compress the air in your pipes, and with it run your engine, without steam, fuel or boiler. You will have no danger from fire or explosion. A safety valve can be placed on your main pipe to carry off surplus pressure. Power can be let all along the line of pipe, and it can be conveyed any distance.

J. H. W. says, in reply to A. K., who asked for a recipe for invisible ink: The following recipe is a good one: No. 1. 1 dram sulphate of copper or of iron, 1 oz. water; put into a bottle. No. 2. 1 dram prussiate of potash, 1 oz. water; put into another bottle. Write with No. 1, using a gold or quill pen. When dry, apply No. 2 with a feather, or lay a wet cloth saturated with the fluid on the writing, when it will be perfectly visible. The writing will be of a dark blue color. This is called invisible ink.

J. H. W. says, in answer to W. B., who asked how to remove ink spots: Use cyanuret of potash or oxalic acid. After the removal of the spots, wash well with water; and if the color of the cloth is taken out, apply ammonia, when it will be instantly restored.

C. H. A. says, in answer to G., who asked how to get ants out of sugar: Every ant in it will, sooner or later, go home with a load, and then return for more. Hence, if the vessel containing sugar or other substance infested by ants be removed from the place where it stood to another, the ants in it will take their loads and depart. Those returning will be like an Irish friend of mine, who, seeking a foot bridge which had once been laid across a stream, exclaimed: "Here it is, an' 'tis gone, sure!" The very last ant will leave in the course of a few hours, but it may be necessary to move the package several times, to prevent those which have found their way home from returning with their friends. I have tried this repeatedly and it has never failed.

G. W. F. says: E., in a recent question, says: "I have several hundred horse power running to waste," etc. It seems to me to be a problem, well worthy of the most serious consideration, how to make the most of water power, particularly where it exists, as your querist states, to the extent of several hundred horse power. The most perfect key to this matter, conceivable, seems to be that mentioned in your last issue as practiced in Belgium, namely, the transmission of power by means of compressed air. The letting of excess power to run anybody's factory readily suggests itself, or even its application for the manufacture of ice.

MINERALS, ETC.—Specimens have been received from the following correspondents, and examined with the results stated:

R. J. says: 1. I send a specimen which completely puzzles me. Recently I had given to me several very rich specimens of gold ore. I extracted the gold by pouring on it 1½ parts of hydrochloric acid to one part of nitric. My object in putting in a larger quantity of hydrochloric than nitric was to precipitate the silver which was in the ore. I left them together until all effervescence ceased; I then had an orange colored liquid, which I evaporated until it got gummy; this I put into a crucible and heated to a white heat, and the specimen herewith was the result. 2. What is the best work on chemistry? Answers: 1. We are afraid that you have been deceived in the appearance of the ore which you imagined contained so much gold. The residue sent us consists largely of the red oxide of iron; and from your account, there is little doubt that you have been trying to extract gold from the bright yellow sulphide of iron, or iron pyrites. The effervescence was caused by the decomposition of the nitric acid, nitrous fumes being evolved. The sulphur was oxidized by the nitric acid into sulphuric acid, which combined with the iron oxide to form sulphate of iron, some sulphur being separated. It was this sulphur which caused the liquid to become gummy when evaporated and heated. The hydrochloric acid, in the presence of the oxidizing nitric, played a minor part. The solution finally contained sulphate of iron, free sulphur, free hydrochloric acid, and perhaps some chloride of iron. The white heat, to which the solution (evaporated to dryness) was finally submitted, decomposed the sulphate of iron, driving off the acids or decomposing them, and there was finally left the red oxide of iron. There may have been some grains of metallic gold, however, as there generally is in iron pyrites, though seldom enough to pay for extraction. The gold can be extracted by the following method: The pyrites is roasted as thoroughly as possible to drive off the sulphur. It is then reduced to powder and agitated with mercury. The mercury combines with the gold present, forming an amalgam of mercury and gold. This amalgam is then submitted to the action of heat, by which the mercury is driven off and the gold recovered in the metallic state. The mercurial vapor is of course condensed, and the metal used for another operation. 2. Bloxam's is highly recommended.

E. B. G.—The stone you send is a hard fine grained limestone, and looks as if it might be available for lithographic purposes, but the specimen is too small for us to judge accurately of its value. A good lithographic stone is of a yellowish gray color, and uniform throughout; free from veins, fibers and spots; a steel point makes an impression on it with difficulty, and the splinters broken off by the hammer have a conchoidal fracture.

E. L. W.—Your specimen is rich in lead, and is probably a lead ocher; but it is too small for complete analysis.

COMMUNICATIONS RECEIVED.

The Editor of the SCIENTIFIC AMERICAN acknowledges, with much pleasure, the receipt of original papers and contributions upon the following subjects:

On Crank Pins. By W. A. S.
On a Balloon Experiment. By D.
On Pressure and Space. By J. A.
On Air and Steam Engines. By F. A. W.
On Perpetual Motion. By J. W. S.
On Traction Engines. By H. M. S.
On the Art of Inventing. By J. E. E.
On Street Pavements. By W. H. B.

Also enquiries from the following:

E. G. de W. & Co.—J. S. B.—D. M.—C. W.—J. J. H.—C. & N.—G. C. F. S,

Correspondents who write to ask the address of certain manufacturers, or where specified articles are to be had, also those having goods for sale, or who want to find partners, should send with their communications an amount sufficient to cover the cost of publication under the head of "Business and Personal," which is specially devoted to such enquiries.

Correspondents in different parts of the country ask: Where can I obtain pipe clay for making lead pencils? Who owns the patent rights for the various artificial stones? Who makes the best candle machine? Does the vapor stove, using crude petroleum, work well practically? Who recently invented a process for tempering and preserving the elasticity of steel and brass springs? Makers of the above articles will probably promote their interests by advertising, in reply, in the SCIENTIFIC AMERICAN.

[OFFICIAL.]

Index of Inventions

FOR WHICH

Letters Patent of the United States

WERE GRANTED FOR THE WEEK ENDING

September 9, 1873,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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APPLICATIONS FOR EXTENSIONS.

Applications have been duly filed, and are now pending for the extension of the following Letters Patent. Hearings upon the respective applications are appointed for the days hereinafter mentioned:

26,454.—RAILWAY SWITCH.—W. Wharton, Jr. Nov. 26.
26,484.—PLATFORM SCALE.—T. Fairbanks. December 3.
26,486.—PIPE MOLDING.—J. Ferth *et al*. December 3.
26,513,—NAIL PLATE FEEDER.—J. Newell. December 3.

EXTENSIONS GRANTED.

15,861.—NUT MAKING MACHINE.—W. E. Ward.
25,434.—COTTON SCRAPER.—J. H. Mitchell.
25,395.—BOOT HEEL.—S. Dodge, Jr., *et al*.
25,442.—PORTABLE FURNACE, ETC.—D. R. Prindle.
25,473.—SCALE.—A. Turnbull.

DISCLAIMER.

24,442.—PORTABLE FURNACE, ETC.—D. R. Prindle.

DESIGNS PATENTED.

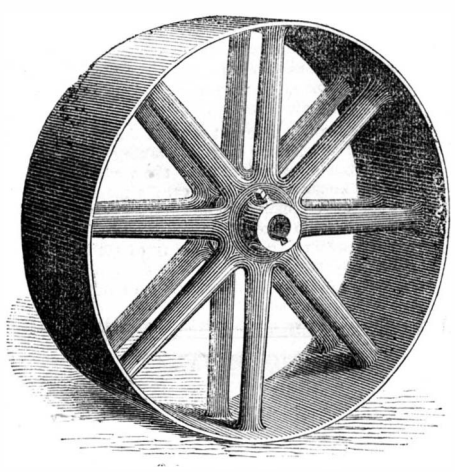
6,874.—SAD IRON HANDLE.—J. Hargrave, Cincinnati, Ohio.
6,875.—CHAIRS.—G. M. Harwood, Troy, N. Y., *et al*.
6,876.—LAMP STAND.—W. H. Perkins, Meriden, Conn.
6,877.—FIRE PLACE STOVE.—S. B. Sexton, Baltimore, Md.
6,878, 6,879.—INKSTANDS.—B. Brower, New York city.
6,880.—RUCHE HOLDER.—D. Kisch, New York city.
6,881.—MONUMENT.—M. Van B. Mitchell, Zanesville, Ohio.

TRADE MARKS REGISTERED.

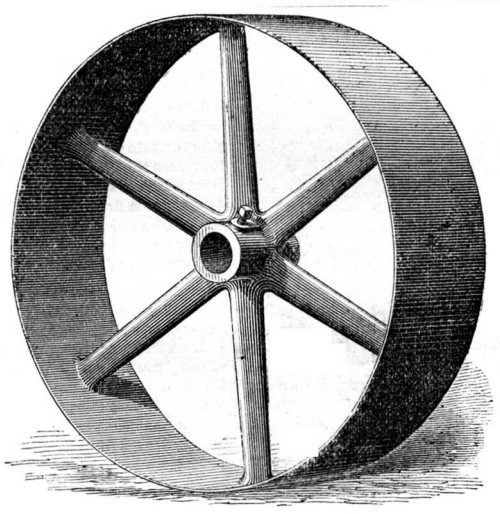
1,442.—LICORICE PASTE.—D. V. Arguimbau, Brooklyn, N. Y.
1,443.—WHISKY.—Derby & Day, St. Louis, Mo..
1,444.—WATCH CASE.—J. C. Dueber, Cincinnati, Ohio.
1,445.—HAT.—J. S. Fayerweather & Co., Danbury, Conn.
1,446.—MEDICINE.—Fenton Manuf. Co., Cleveland, Ohio.
1,447.—SEEDS.—D. M. Ferry & Co., Detroit, Mich.
1,448.—WHISKY.—W. M. Fliess & Co., New York city.
1,449.—HOSIERY.—Smyth & Co., Balbriggan, Ireland.
1,450.—GOLD RINGS.—Dueber Watch Case Co., Cinn., O.

SCHEDULE OF PATENT FEES:

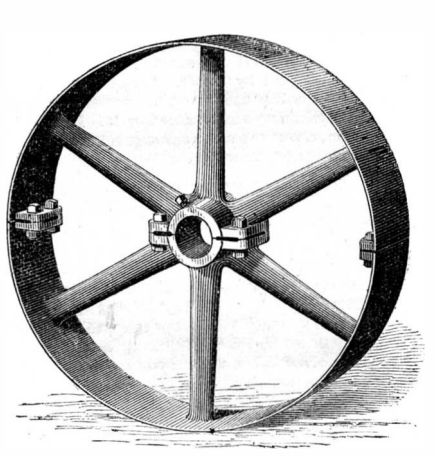
On each Caveat	$10
On each Trade-Mark	$25
On filing each application for a Patent (17 years)	$15
On issuing each original Patent	$20
On appeal to Examiners-in-Chief	$10
On appeal to Commissioner of Patents	$20
On application for Reissue	$30
On application for Extension of Patent	$50
On granting the Extension	$50
On filing a Disclaimer	$10
On an application for Design (3½ years)	$10
On an application for Design (7 years)	$15
On an application for Design (14 years)	$30



DOUBLE ARM PULLEY.



PLAIN PULLEY.



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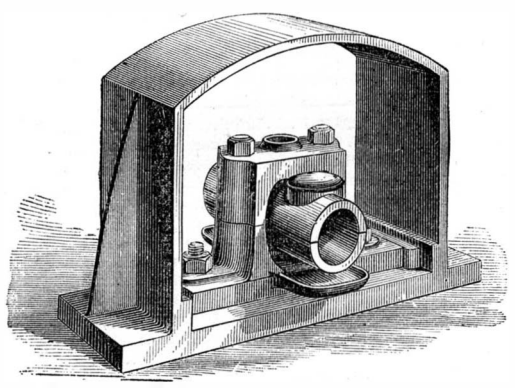
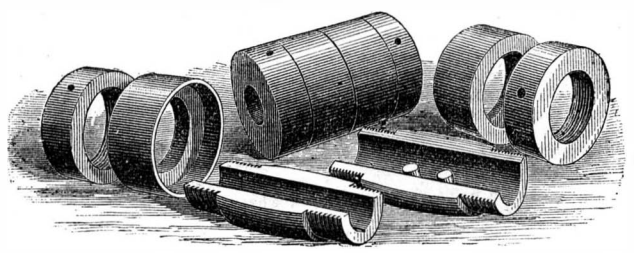


WALL BEARING.



COLLINS' PATENT COUPLING.

—:o:—

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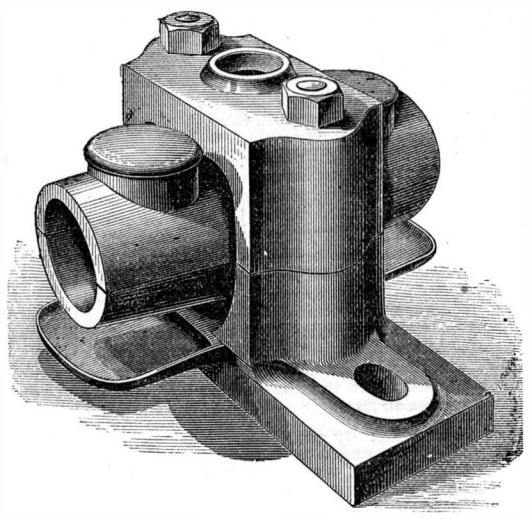
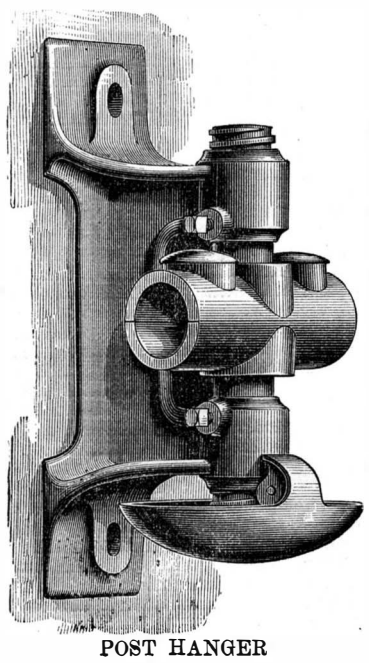


PILLOW BLOCK.



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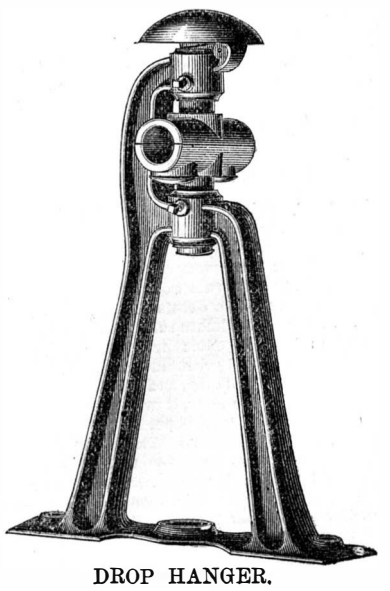

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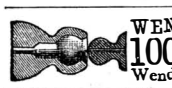

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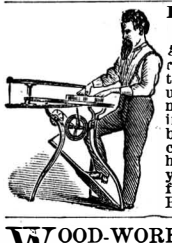

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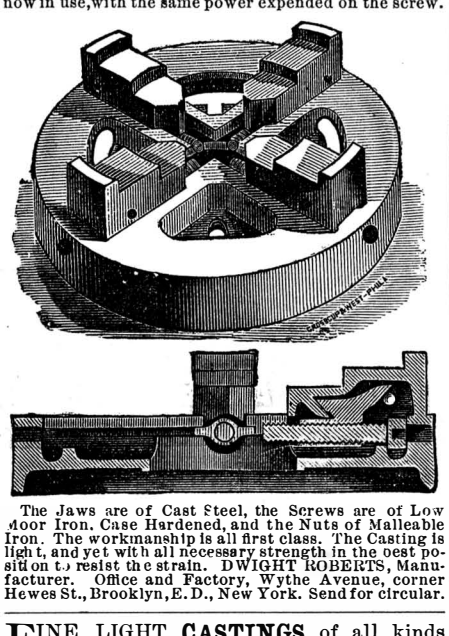

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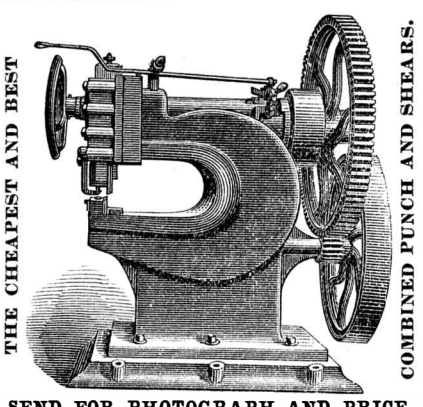

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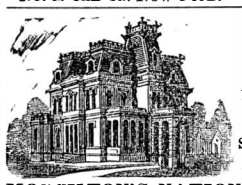

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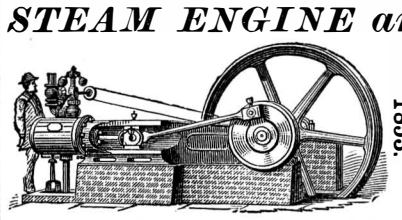

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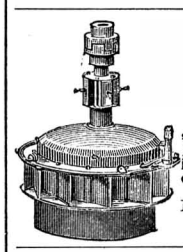

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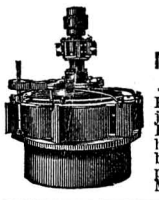

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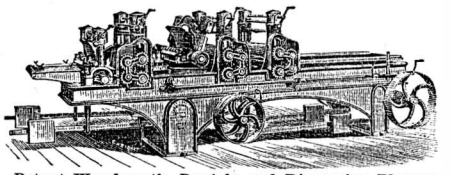

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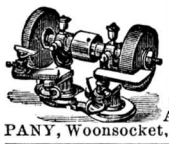

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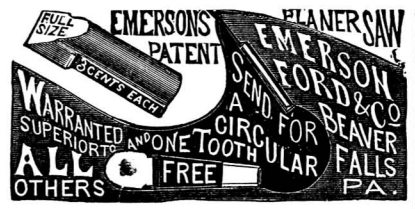

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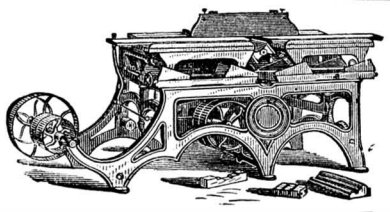

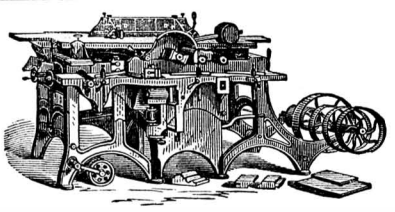

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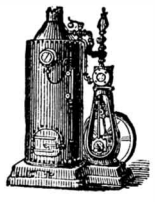

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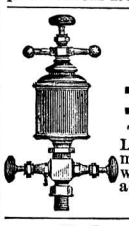

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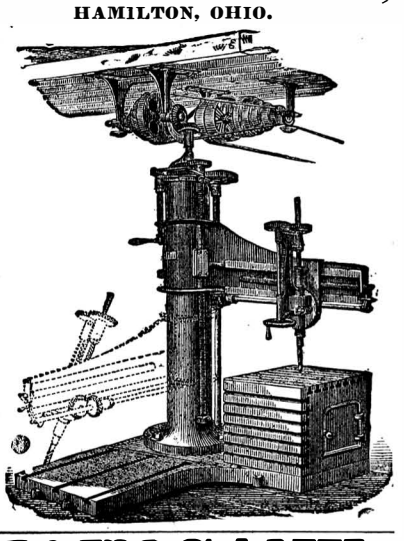

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